United States Patent [19]

Mulligan

[11] **3,803,822**

[45] **Apr. 16, 1974**

[54] **RADIATION SENSITIVE ENDS DOWN DETECTING APPARATUS AND METHOD**

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

[21] Appl. No.: **97,521**

[52] **U.S. Cl.** ..... **57/34 R,** 250/219 S

[51] **Int. Cl.** **D01h 13/16**

[58] **Field of Search** ..... 356/199, 200, 238; 250/219 S; 57/81, 34 R

[56] **References Cited**

UNITED STATES PATENTS

3,391,840	7/1968	King	250/219 S
3,523,413	8/1970	Ford et al.	57/81
3,523,414	8/1970	Black et al.	250/219 S X

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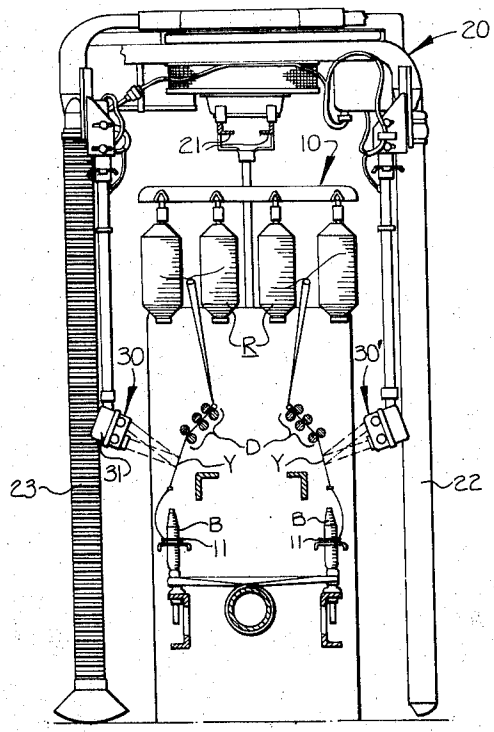
[57] **ABSTRACT**

An apparatus and method for detecting ends of yarn on a textile yarn forming machine such as a spinning machine wherein radiation source and radiation detector mounted on and movable with a traveling unit direct radiation toward ends of yarn and respond to radiation reflected therefrom, the impingement of radiation onto the detector being amplified at a low signal to noise ratio through concentration of reflected radiation by a static reflector.

1 Claim, 2 Drawing Figures



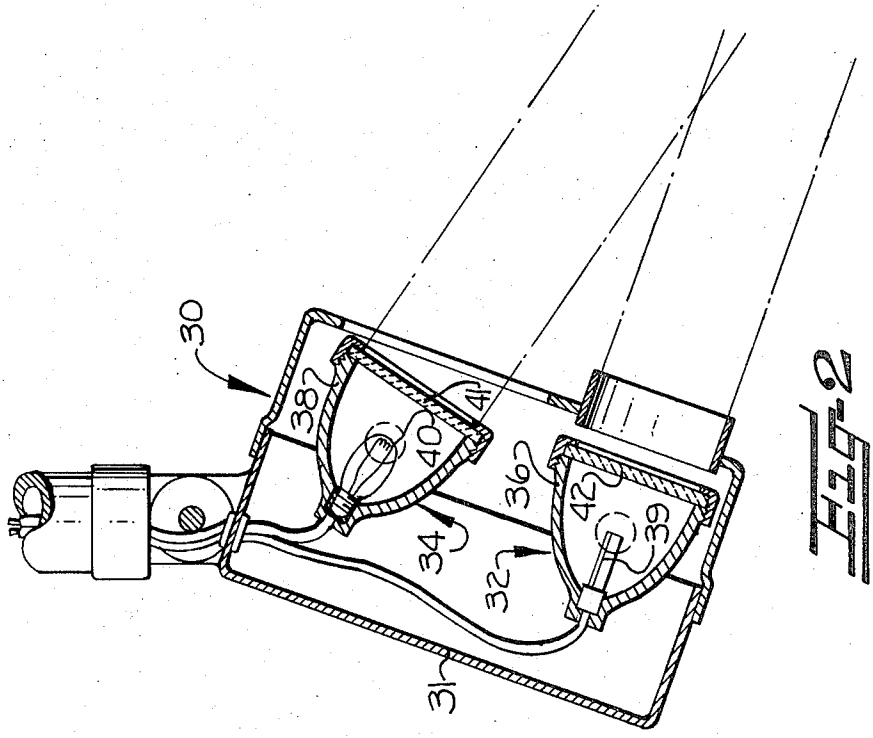


FIG. 2

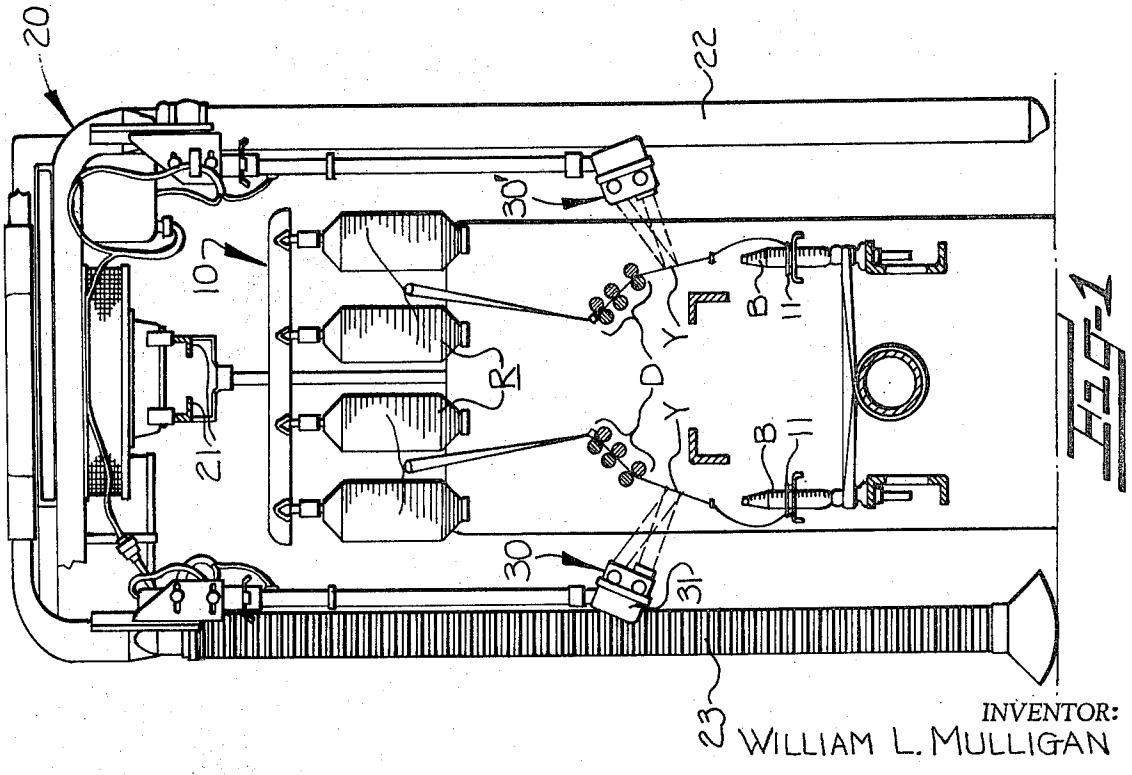


FIG. 1

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RADIATION SENSITIVE ENDS DOWN DETECTING APPARATUS AND METHOD

This invention is related to inventions owned in common with the present invention and disclosed in patents and applications entitled "Apparatus and Method for Detecting, Piecing-Up and Reporting Ends Down on Spinning Machines," U.S. Pat. No. 3,486,319 issued Dec. 30, 1969; "Apparatus and Method For Detecting and Reporting Ends Down on Textile Machines," U.S. Pat. No. 3,523,413 issued Aug. 11, 1970; and "Electric Circuit Means For Textile Strand Ends Down Detecting Apparatus," filed Oct. 1, 1970 under Ser. No. 77,101, now U.S. Pat. No. 3,659,409 issued May 2, 1972.

It has previously been proposed that the efficiency of textile machine operators, and particularly of spinners working in the spinning room of a textile mill, may be improved by providing apparatus including a detector mounted on or traveling with a traveling unit such as a pneumatic cleaner, for patrolling textile yarn forming machines as the traveling unit traverses the same and for providing an indication of those textile machines or sides of machines in need of correction of improper conditions, that is in need of the putting up of ends down. Such apparatus and components of circuitry therefor are the subject matter of the aforementioned related patents and application.

Operating apparatus in accordance with the teachings of the aforementioned related patents and application have been constructed in which radiation in the form of visible light from a source such as an incandescent lamp is directed toward ends of yarn on a textile yarn forming machine and visible light reflected from the ends of yarn is detected by a photomultiplier tube of conventional construction. While such operating embodiments are successful in determining the absence and presence of yarns formed on a traversed machine, certain difficulties have been encountered in maintaining an accurate determination of the presence and absence of ends of yarn under certain adverse conditions.

More particularly, the amount of visible light reflected from the ends of yarn is relatively small and substantial amplification is required to raise any related electrical signal to the level needed for distinguishing between the presence and absence of ends of yarn at the yarn forming locations. In prior operating embodiments, such amplification has been successfully accomplished through the use of photoemissive devices, and particularly photomultipliers as mentioned above. Photomultipliers are known to have tremendous amplification capability, and rely upon secondary electron emission in responding to low light levels. One substantial disadvantage of the photomultiplier is that thermionic emission originating within the photomultiplier is amplified together with any light initiated signal and appears as a significant noise component in the resultant total signal where high sensitivity is sought. The presence of such noise is often further complicated by the relatively high ambient levels of visible light typically found in a textile mill room where the apparatus is operating. High ambient illumination levels and high signal to noise ratios have, in particularly severe circumstances, combined with other factors in the overall apparatus arrangement to bring about unacceptable inaccuracies in determination of the presence and absence of yarn.

In view of the above, it is an object of the present invention to avoid the introduction of noise into a signal indicative of radiation reflected from an end of yarn being formed on a textile yarn forming machine, through amplification at a low signal to noise ratio. In accomplishing this object of the present invention, reliance is placed upon a static, radiation concentrating means which gathers and concentrates reflected radiation without introducing extraneous emissions such as occur in a photomultiplier. As will be recognized from the disclosure which follows, the use of a static means for amplification of the effect of radiation reflected from ends of yarn eliminates the possibility of noise introduction by thermionic emission or similar effects as is common with any active amplification means such as the photomultipliers used in prior related developments.

Some of the objects and advantages of the invention having been stated, others will appear as the description proceeds, when taken in connection with the accompanying drawings, in which:

FIG. **1** is an end elevation view, in partial section, of an apparatus in accordance with the present invention shown during traversal of a textile yarn forming machine; and

FIG. **2** is an enlarged elevation, in section, through a detector head forming a portion of the apparatus of FIG. **1,** illustrating more particularly the arrangement of radiation source and radiation detector in accordance with the present invention.

Referring to the drawings, the apparatus of the present invention is there disclosed in operating relation to a textile yarn forming machine, namely a ring spinning frame **10.** While only a single spinning frame **10** is illustrated, it is to be understood that the frame **10** may be of one of a substantial number of spinning machines arranged in rows in a spinning room, in patterns which are substantially conventional. A traveling unit, here illustrated as a pneumatic cleaner **20,** is supported above the textile machine **10** for traversing the same along a predetermined path of travel. The specific apparatus chosen for illustration in the drawings is substantially identical to the fourth embodiment of the traveling pneumatic cleaner disclosed in U.S. Pat. No. 3,304,571 issued on Feb. 21, 1967 and owned in common with the present invention, but it must be understood at the outset that a wide variety of other patrolling devices are contemplated as useful in the combination of this invention and that the invention is accordingly not to be limited solely to traveling cleaners.

The traveling cleaner **20** is supported for movement along a track **21** extending above the spinning frame **10** and includes blowing and sucking air sleeves **22** and **23** depending on either side of the spinning frame **10** from a main fan housing, for removing lint and the like from the spinning frame **10** and the floor by currents of air. As is disclosed more fully in the aforementioned patent directed to the cleaner structure, drive means and a fan are provided for inducing the flow of currents of air for such cleaning. While the traveling cleaner **20** may be arranged to traverse a plurality of textile machines such as the spinning frame **10,** the present invention contemplates also that the traveling cleaner **20** or the manner in which the cleaner is supported and arranged for traversing a textile machine may be changed in

varying ways, including limiting the path of travel of the cleaner to traversal of a single machine only.

Conventional ring spinning frames in wide use in the textile industry of the world at the present time include a creel portion wherein a plurality of bobbins of roving R are suspended, drafting systems D to which the roving is supplied, and spindles equipped with bobbins B on which spun yarn is wound. In spinning the yarn Y in conventional manner and packaging the yarn onto bobbins B mounted on the spindles of the spinning machine **10,** roving passes through the drafting systems D to travelers mounted on spinning rings **11** encircling each of the plurality of spindles driven in rotation from the center shaft or tape drum of the machine. In passing between the drafting systems and the travelers, the yarn Y is exposed to detection by means mounted within a detector head **30** as will now be described.

The detector head **30** depends from the traveling cleaner **20,** between the blowing and sucking air sleeves thereof, and includes a casing **31** which encloses a radiation detector generally indicated at **32** and a radiation source generally indicated at **34.** As proposed in the aforementioned related patents and application, the traveling cleaner **20** mounts two of such detector heads **30, 30'**, for monitoring both sides of the spinning frame **10** during traversal thereof by the traveling cleaner **20.** For purposes of the present disclosure, discussion will be directed particularly to one detector head **30,** with it being understood that both of the detector heads **30, 30'** are identical in structure and operation.

The radiation detector **32** will be noted as including a detector casing **36** having a sensing element **39** disposed therewithin. Desirably, the sensing element **39** is a photoconductive element such as a sulfide resistor conducting a flow of electrical current which is dependent upon impingement of radiation. Through provision of the element **39,** the radiation detector **32** is rendered responsive by electrical variation to radiation such as is reflected from the ends of yarn Y normally being formed at locations along the spinning frame **10.**

In accordance with the present invention, static, reflective radiation concentrating means is mounted in predetermined relation to the sensing element **39** for amplifying at a low signal to noise ratio the impingement thereonto of radiation reflected from ends of yarn Y. Desirably, the concentrating means is defined by a parabolic internal surface of the detector casing **36** reflective as to radiation emitted by the radiation source **34,** with the sensing element **39** having its active portion lying at the focus of the parabolic surface (FIG. **2**). As will be understood, the internal surface of the casing **36** concentrates onto the sensing element **39** radiation which reaches the detector **32** from within a predetermined, generally right circular cylindrical, field of view (illustrated by phantom lines in the drawing).

For purposes of minimizing the maintenance required by the radiation detector **32,** and for other reasons which will be brought out more fully hereinafter, it is preferred that the radiation to which the detector **32** responds be radiation in the range of wavelengths known as infrared and that the sensing element **39** be a lead sulfide resistor. Where infrared radiation is employed, the reflective surface of the detector casing **32** which functions as the static, reflective radiation concentrating means and which amplifies the impingement of radiation onto the sensing element **39** may be a polished metal surface which need not be silvered or otherwise specially treated. Polished metal surfaces having characteristics of reflectivity for infrared radiation more readily maintain a high reflectivity under textile mill operating conditions than do those surfaces which are highly reflective at wavelengths visible to the human eye. As is known, the concentrating and amplifying effects of a parabolically curved surface may be employed for substantially all wavelengths of radiation, including light visible to the human eye, but the difficulty of maintaining a highly reflective surface for visible light renders the choice of visible light as the radiation used less than wholly desirable where a static, radiation concentrating means as contemplated by this invention is used.

Radiation reaching the detector **32** from ends of yarn Y, for concentration onto the sensing element **39,** originates from a radiation source **34** including a source casing **38** within which is mounted a suitable means for emitting radiation, such as a suitable incandescent lamp **40.** Desirably, the housing **38** includes a generally parabolic interior surface wall reflective for radiation of the type to which the detector **32** responds, and the filament of the incandescent lamp **40** is positioned generally at the focal point of the parabolic surface. Where infrared radiation is employed, the incandescent lamp **40** is selected to be a type emitting radiation rich in infrared wavelengths and a screening filter **41** is positioned to ensure that radiation directed outwardly of the source **34** is of a desirable wavelength characteristic. Tuning of the detector **32** and source **34** to a common band of infrared radiation is accomplished by the provision of a corresponding filter **42** in the radiation detector **32.**

It is to be noted that the infrared radiation source **34** and infrared radiation detector **32** are mounted within the detector head **30** so that the generally right circular cylindrical fields thereof intersect in an elongate zone spaced forwardly of the detector head **30** (dotted lines in FIGS. **1** and **2**). As will be understood, the "tunnel" field of view available to the infrared radiation detector **32,** being substantially right circular cylindrical throughout its extent, ensures proper response of the infrared radiation detector to infrared radiation emitted from the source **34** and reflected from an end of yarn Y at any point within the intersecting zone of the fields of the source **34** and detector **32** even should that zone be displaced toward or away from the spinning frame **10.** By this means, incorrect responses otherwise possibly introduced by sway or deflection of the detector head **30** due to movement of the traveling cleaner **20** are minimized.

The adoption of the infrared band of wavelengths as the radiation to which the source **34** and detector **32** are tuned provides other and further benefits, in the combination of this invention, in that infrared detectors having the characteristics described above are more rugged than photomultipliers and thus more easily withstand any rough usage occurring in a textile mill application. Further, such infrared detectors operate at lower voltage levels than photomultipliers and are available at lower cost, thereby opening possibilities for more economical construction and maintenance for the combination of the present invention. Finally, the ambient level of infrared radiation in a textile mill room is quite low, as compared to visible light, so as to facili-

tate reliance on the static, radiation concentrating means of this invention in obtaining the needed amplification of radiation reflected from ends of yarn.

What is claimed is:

1. In an apparatus for monitoring ends of yarn normally being formed at locations along a textile yarn forming machine and including a traveling unit movable relative to the yarn forming locations, a radiation source mounted on the traveling unit and moving therewith for directing radiation toward ends of yarn being formed at the yarn forming locations, a radiation detector mounted on the traveling unit and moving therewith and having a sensing element for responding by an electrical variation to radiation impinging thereon, and electronic circuitry operatively connected with the detector for distinguishing between electrical variations of said sensing element indicative of the presence and absence of ends of yarn at the yarn forming locations, that improvement which comprises first casing means enclosing said radiation source and defining a parabolic surface for reflecting radiation emitted therefrom into a collimated beam, filter means on said first casing means for tuning radiation projected therefrom to a predetermined range of infrared radiation wavelengths; second casing means enclosing said sensing element and defining a parabolic surface lying in predetermined relation to said sensing element for concentrating the impingement onto said sensing element of radiation reflected from ends of yarn being formed at the yarn forming locations, said parabolic surface concentrating onto said sensing element radiation projected from said first casing means and reflected to said sensing element from within a predetermined field of view, and filter means on said second casing means for limiting radiation reaching said parabolic surface thereof to said predetermined range of wavelengths.

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