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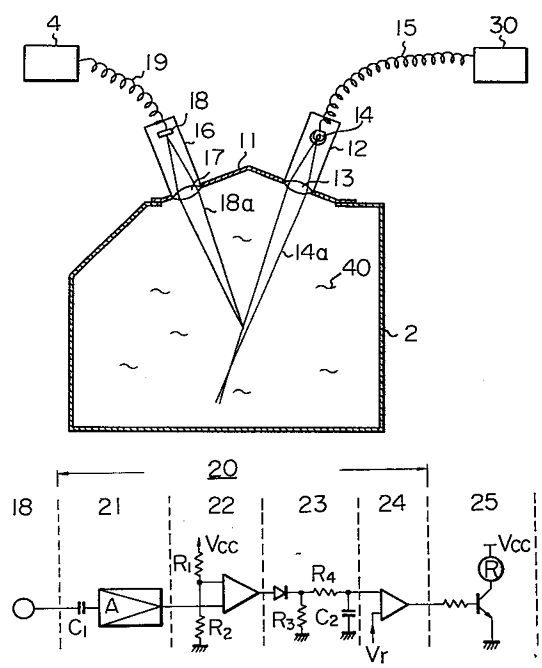
(54) METHOD AND DEVICE FOR DETECTING END BREAKAGE OF FINE SPINNING FRAME.

(57) Method and device for the detection of an end breakage by detecting a fiber floating and moving in the pneumatic main duct of a fine spinning frame. The output of a photocell (18) detecting scattered light via a fiber crossing an optical beam formed at a predetermined position in a pneumatic main duct (2) is converted into a voltage pulse, which is then amplified, and only voltage pulses higher than a predetermined value are produced, and are integrated over a predetermined period of time. When the integrated value exceeds a set value, it is regarded to be the occurrence of an end breakage, and an identification signal is generated.



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DESCRIPTION

TECHNICAL FIELD

This invention relates to a method and an apparatus for detecting yarn breakage in a spinning frame, more especially, to a method and apparatus for detecting yarn breakage by detecting fibers floating forward in a pneumatic duct when yarn breakage occurs in the spinning frame.

BACKGROUND ART

The main method used hitherto to detect yarn breakage in a spinning frame has been to apply light upon the yarn moving between a front roller and a snail wire in the spinning frame and to detect the existence of the yarn in the light by a photocell. For example, Japanese Examined Patent Publication (Kokoku) No. 48-2569 discloses a method in which a detecting device having a photocell is arranged on a moving unit traversing between a plurality of frames of the spinning frames and yarn breakage of a spindle facing the moving unit is detected along with movement of the moving unit.

Methods of detecting yarn breakage other than detection of the yarn path by a photocell include detection by sensing the oscillation of the yarn during spinning using a snail wire and, as disclosed in Japanese Examined Patent Publication No. 48-4894, detection of yarn breakage by providing a lever equipped with a snail wire at one end and equipped with a light energy absorbing member at the other end and by absorbing the light flowing along the front of the spinning frame when yarn breakage and loss of support by the snail wire cause the lever to swing and the light energy absorbing member to move downward.

Further, Japanese Examined Patent Publication

No. 49-38372 discloses a method arranging a yarn breakage sensing member to travel at the front of the spinning frame or other textile machine at a constant speed and detecting yarn breakage by whether or not yarn contacts the sensing member when the sensing member travels along the frame of the textile machine.

These known methods for detecting yarn breakage either detect yarn breakage by means of a member contacting a yarn during spinning or detect the same without contacting the yarn but by using a photocell, wherein a moving unit mounted with a detecting device is arranged between frames of the spinning frames. Use of a member contacting the yarn during spinning has the risk of increasing yarn breakage by the yarn breakage detection operation. Also, use of a moving unit makes it possible to detect yarn breakage of only spindles in front of the moving unit. In either case, large equipment costs are required.

Recently, there have been proposed, for example, in Japanese Unexamined Patent Publication No. 57-77328, a method for detecting yarn breakage by projecting light from a light projector into a pneumatic duct or a pipe branching from the duct and connecting to a flute and receiving by a light receiving device the light reflected when fibers pass through the light curtain formed by the projected light and, for example, in Japanese Unexamined Patent Publication No. 57-77329, a method for detecting yarn breakage by having light reflected due to the projected light received by a light receiver and detecting variation in the amount of reflected light due to interruption of the reflected light by floating fibers passing through a pneumatic duct when yarn breakage occurs. However, these methods are said to suffer from problems of detection accuracy and have still not reached the practical stage.

DISCLOSURE OF THE INVENTION

It is an object of the present invention to overcome the drawbacks of the known methods and to provide a practical and easily operable method and a practical and inexpensive apparatus for detecting with a high degree of accuracy yarn breakage in all spindles of a spinning frame.

The object is achieved by applying incident light on fibers floating through in a pneumatic duct of a spinning frame and detecting the light scattered by the fibers by a photoelectrical element.

Namely, the essential technical idea of the method and the apparatus for detecting yarn breakage in accordance with the present invention is to apply a light beam emitted from a light projector at a predetermined position in a pneumatic main duct and, when fibers passing transversely through the light beam exist, to detect light scattered by the fibers as electrical pulse signals by a photo-electrical system and recognize the electrical pulse signals as yarn breakage when successively repeated more than a predetermined instances per unit time. The recognition of the electrical pulses signals is achieved by integrating the pulse signals in unit time and by comparing the integrated value with a predetermined value (voltage).

One necessary condition for a practical apparatus is reliability of operation as a detection device. At issue with this type apparatus is whether it can reliably detect the light scattered when floating fibers pass through the pneumatic duct and pass through a detection position of this apparatus, i.e., if the floating fibers occurred due to yarn breakage or not. If it cannot detect this reliably, the method and the apparatus of the present invention would not be practical. From this viewpoint, the apparatus for detecting yarn breakage in accordance with the present invention has a built-in system for checking the reliability of detection.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a perspective view of an apparatus for detecting yarn breakage in accordance with the present invention mounted on a pneumatic duct of a spinning frame;

Figure 2 is a cross-sectional view of a detecting device of the apparatus for detecting yarn breakage mounted in a cross-sectional plane of a pneumatic duct;

Figure 3 is a block diagram of the essential electrical circuit of the apparatus for detecting yarn breakage;

Figure 4A is a diagram of the output waveform of an amplifier 21;

Figure 4B is a diagram of an output waveform of comparator 22;

Figure 4C is a diagram of an output waveform of an integration circuit;

Figure 5 is a block diagram of a practical electric circuit of the apparatus for detecting yarn breakage in accordance with the present invention; and

Figures 6A, 6B, 6C, 6D, 6E, 6F, 6G, 6H, and 6I are waveform diagrams of waveforms of electrical signals appearing at points A, B, C, D, E, F, G, H, and I of the electrical circuit illustrated in Fig. 5, respectively.

BEST MODE FOR CARRYING OUT THE INVENTION

To facilitate understanding of the present invention, the essential technical idea behind the method and apparatus for detecting yarn breakage in accordance with the present invention is described in detail with reference to the attached drawings.

A spinning frame is usually provided with a pneumatic device to suck up and hold fleece generated along with yarn breakage. As shown schematically in Fig. 1, the pneumatic device is comprised of pneumatic flutes 3 equipped with suction holes corresponding to the spindles of the spinning frame, pneumatic ducts 2 for transporting the air and the fleece from the pneumatic flute, and a case accommodating a pneumatic suction device 1 consisting of a reservoir for holding the fleece transported from the duct and a suction fan.

The pneumatic duct 2 is illustrated in Fig. 1 as two uniform-shape ducts. Each pneumatic duct 2, however, is actually formed with an increasingly large sectional area from the position farthest from the suction fan to the position closest to the suction fan so as to achieve uniform suction in accordance with the amount of air passing in the duct. Further, while one pneumatic duct is usually arranged on each side of the spinning frame near to the pneumatic suction device case 1, i.e., a total of two, sometimes the two pneumatic ducts are joined into one just in front of the case 1 for connection with the case 1.

The apparatus for detecting yarn breakage in accordance with the present invention is comprised of a detecting unit 10 of the detecting device and a panel box 4 housing electrical circuits. The panel box 4 is provided with lamps for indicating yarn breakage.

As illustrated in Fig. 1, the detecting unit 10 of the detecting device is arranged on an end portion adjacent to the case 1 of the pneumatic duct 2. As illustrated in Fig. 2, the detecting unit 10 is comprised of a light projector 12 and a light collector 16. The light projector 12 and the light collector 16 are fixed on an attaching member 11 of the detecting device after being adjusted in inclined angles so that the focus of the light collector 16 substantially matches the passage of incident light from the light projector. In this case, to increase the sensitivity of the light collector 16, it is preferable to arrange the light projector 12 and the light collector 16 so that the focus of the incident light from the light projector 12 substantially matches the focus of light collected by the light collector 16. Attachment of the detecting unit 10 to the pneumatic duct 2 is achieved by fixing the attaching member 11 to the pneumatic duct 2 by means of bolts or other suitable means. To facilitate alignment of the relative positions of the incident light and collected light, it is preferable to insert between the light projector 12 and the attaching member 11 and between the light collector 16 and the attaching member 11 an angle adjusting and fixing member capable of adjusting freely and fixing the angle between the light projector 12 and the light collector 16.

It is also possible to attach individually and directly the light projector 12 and the light collector 16 to the pneumatic main duct. In this case, it is also preferable to insert an angle adjusting and fixing member between the light projector 12 and the pneumatic duct and between the light collector 16 and the pneumatic duct.

The light projector 12 has a light source 14 and a projection lens 13 collecting light emitted from the light source 14. The light source 14 is connected through a lead wire 15 to a power supply 30.

The light collector 16 has a light collectig lens 17 collecting light scattered from the fibers reflecting the incident light and has a photocell 18 connected through a lead wire 19 to an electric circuit housed in the panel box 4. As illustrated in Fig. 3, the electric circuit is comprised of an amplification circuit 21, a comparator circuit 22, an integration circuit 23, and a comparator circuit 24. A predetermined voltage Vr which acts as a comparative standard is supplied to the comparator circuit 24. For the convenience of explanation, the electric circuit will be called an amplification, comparison, and judgement circuit 20 (ACJ circuit 20) hereinafter. As illustrated in Fig. 3, an output of the ACJ circuit 20 is connected to an alarm circuit 25 having an alarm R.

Various devices may be used for the alarm R of the alarm circuit 25. For example, as illustrated in Fig. 1, an alarm indicating lamp arranged on an end of the frame in the spinning frame may be used as the alarm.

An alarm indicating lamp is convenient for informing operators at positions far from the spinning frames of the existence of spinning frames with yarn breakage. Further, a blinking type alarm indicating lamp is useful for informing operators of the existence of spinning frames with yarn breakage more speedily. Further, central placement of the alarm indicating lamps of a plurality of spinning frames in a spinning room in a specific place of the spinning room and, thereby, central monitoring of the yarn breakage situation of the spinning frames in the spinning room is useful for discovering speedily frames having yarn breakage and for obtaining an overall grasp of the spinning conditions of all the spinning frames and managing the same.

The alarm used may also be a buzzer or a buzzer with an alarm indicating lamp. When there are only a few yarn breakage indications and, therefore, there are only relatively few operators in the spinning room, the sound of a buzzer is effective for informing the operators of the yarn breakage.

The gist of the method of the present invention will become clear by the following explanation of the operation of the essential constitution of the apparatus for detecting yarn breakage of the present invention as illustrated in Fig. 1, Fig. 2, and Fig. 3. Namely, the method for detecting yarn breakage of the present invention is as follows.

When yarn breaks, fleece is delivered from a draft part corresponding to the yarn breakage spindle. The fleece is sucked from a hole 3 into the pneumatic flute and is sent through the successively larger diameter pneumatic duct toward the case 1 for final accumulation and storage in the pneumatic fleece reservoir (not shown).

The fleece passing through the apparatus for detecting yarn breakage, which apparatus is, as illustrated in Fig. 1, arranged at a position in the pneumatic main duct adjacent to the pneumatic suction device case 1, is dispersed into a plurality of fibers 40 or fiber groups consisted of a plurality of fibers (called simply "fibers 40" hereinafter) by an air stream passing inside the duct, as illustrated in Fig. 2, and floats forward in the duct.

When light is incidented by the light projector 12 into the pneumatic main duct, in which the plurality of fibers 40 are irregularly distributed, the light is scattered by the fibers and, viewed in the direction inclined with respect to the direction of the incident light, the passage of the incident light may be seen as flickering. The photocell 18 of the light collector 16, focused toward the passage of the light in the incident light, therefore generates a pulse in response to each flicker of the light beam of the incident light due to the scattering of the light beam by the fibers, i.e., due to the Tyndall effect.

When there is no yarn breakage and there is only a small quantity of fibers floating in the pneumatic duct 2, the frequency of pulse generation is low, as illustrated in the time t_{01} of Fig. 4B. However, when yarn breakage occurs in even one spindle of the spinning frame, the frequency of pulse generation increases, as illustrated in the time t_b of Fig. 4B. On the other hand, when the yarn breakage is corrected and the quantity of fiber floating in the pneumatic duct 2 decreases, the frequency of pulse generation again decreases, as illustrated in the time t_{02} of Fig. 4B. In Fig. 4B, the vertical axis represents the intensity (V) of pulse (Voltage) and the horizontal axis represents the time (T).

The pulses output from the photocell 18 are supplied through the lead wire 19 to the ACJ circuit 20. The pulses pass through the amplification circuit 21 and the comparator circuit 22 to the integration circuit 23 for integration. Namely, when yarn breaks and numerous fibers 40 float forward in the pneumatic duct, the frequency of pulse generation per unit time is high. The integration of the pulses by unit time thereby results in an increased integrated voltage level in the integration circuit 23. When there is no yarn breakage, no rise is obtained in the integrated voltage level in the integration circuit 23.

The output signal of the integration circuit 23 is input to the comparator circuit 24. The predetermined setting voltage Vr, which functions as the standard, is supplied to the comparator circuit 24. The output signal from the integration circuit 23 and the setting voltage Vr are compared and, when the voltage level of the output signal is higher than the level of setting voltage Vr, the alarm circuit 25 is activated.

As apparent from the above description, when yarn breakage occurs simultaneously in two or more spindles in the same spindle row of the same spinning frame, the frequency of pulse generation becomes abnormally large compared with yarn breakage in one spindle. Therefore, adjustment of the setting voltage Vr to a comparatively large value enables adjustment of the apparatus so that the ACJ circuit does not output a signal upon yarn breakage in one spindle, in other words, enables the apparatus for detecting yarn breakage to accept single spindle yarn breakage. Experiments have shown, however, that reliable detection of single spindle yarn breakage is desirable in well managed spinning factories from the point of view of maintaining yarn quality and that doing this does not in the end lead to an increase in the operations necessary for running the spindle frames.

The method for detecting yarn breakage of the present application is also characterized by projecting light into the pneumatic duct, receiving light scattered by the fibers floating through the duct by the light collector and converting it into pulse signals, continuously integrating the pulses by unit time to find the integrated value (electric quantity), comparing the integrated value with the standard value predetermined to correspond to control target number of yarn breakages, and, when the integrated value reaches the standard value, indicating this by electric signals.

Next, a practical apparatus for detecting yarn breakage is described in detail with reference to Fig. 5.

Blocks 21, 22, 23, 24, and 25 illustrated by the chained lines in Fig. 5 correspond to circuit blocks 21, 22, 23, 24, and 25 of Fig. 3. Block 26, i.e., a circuit for detecting abnormalities 26 (described hereinafter) in Fig. 5, however, is not illustrated in Fig. 3. Below, the operation of the circuit in Fig. 5 is described with reference to waveform diagrams in Fig. 6A through Fig. 6I. Now, Fig. 6A through Fig. 6I illustrate the waveforms of signals appearing in points A through I in Fig. 5, respectively.

(1) An output signal (A) from the photocell 18 is supplied to a capacitor C_1. This output signal from the photocell 18, as illustrated in Fig. 6A, consists of a direct current component and an alternating current component overlying the direct current component. Here, the direct current component expresses the light quantity corresponding to the usual luminous environment around the photocell 18, while the alternating current component expresses the light quantity corresponding to the light reflected by floating fibers. Therefore, the direct current component corresponds to outside disturbances. The only component really necessary for detéction of yarn breakage is the alternating current component. Therfore, the output signal from the photocell 18 is supplied to a capacitor C_1 to eliminate the unnecessary direct current component. That is, only the alternating current component is obtained, as illustrated in Fig. 6B.

(2) The pulses of the alternating current component

from the capacitor C_1 are amplified to the predetermined level in the amplification circuit 21. As illustrated in the drawings, the amplification circuit 21 is, for example, comprised of an amplifier 21-1 and a buffer amplifier 21-2. The output signal from the amplifier 21-1 and the output signal from the amplifier 21-2 have the waveforms illustrated in Fig. 6C and Fig. 6D, respectively.

(3) The output pulse signal sent out from the amplification circuit 21 is supplied to the comparator circuit 22. As illustrated in Fig. 6D, the output pulses from the amplification circuit 21 each have different amplitudes. This is a result of the fact that the distance between the focus of the light collector 16 and the floating fibers continually fluctuates during operation. To equalize the irregularity of amplitude of the output pulses due to the above-mentioned fluctuation, comparator circuit 22 corrects the irregularity of amplitude illustrated in Fig. 6D to produce output pulses of a uniform amplitude as illustrated in Fig. 6E. Now, the comparator circuit 22 can also simultaneously eliminate noise and other needless signals. Namely, the comparator circuit 22 is supplied with the setting voltage V_1. The comparator circuit 22 outputs uniformly all pulses over the level of setting voltage V_1 as constant amplitude pulses, as illustrated in Fig. 6D, and removes noise and other needless signals not reaching the level of V_1. Accordingly, output pulses having a uniform amplitude and free of noise, as illustrated in Fig. 6E, are obtained.

(4) The output pulses from the comparator circuit 22 are supplied to the integration circuit 23 for integration. As described hereinbefore, the integrated voltage level changes according to the number of output pulses. The integration circuit 23 consists of a so-called CR integration circuit and has integration time constants determined by C_2 and R_4. Figure 6F

illustrates that the integrated voltage level fluctuates according to the number of output pulses.

In this way, selection of the time constants of the integration circuit enables an integrated voltage level of a value proportional to as low as one yarn breakage. Therefore, this value can be used to detect occurrence of yarn breakage. In actuality, however, there is the following problem. With reference to Fig. 2, in the pneumatic duct 2, the focus of light collector 16 is converged into one point and floating fibers are detected by their passage through that one point. Namely, all the floating fibers are represented by the floating fibers passing through the one point. Therefore, if there are floating fibers, but the quantity of fibers to be represented is few, a valley portion as indicated by P in Fig. 6F appears. Consequently, the detecting system becomes unreliable. One possible method for solving the problem may be to set larger time constants $C_2 \cdot R_4$ in the integration circuit 23, namely to use time constants having a slow curve in which no valley is formed so as to cause the integrated voltage to rise. However, this method conversely has the problem of delayed response time, making speedy detection of yarn breakage impossible.

(5) Therefore, in the comparator circuit 24 of Fig. 5, a comparator 24-1 and a comparator 24-2 are introduced and a flip-flop 24-3 is provided downstream of the same. The comparator 24-1 and the comparator 24-2 are given a setting voltage V_{r1} and a setting voltage V_{r2}, respectively. The level of V_{r1} and V_{r2} are indicated in Fig. 6F. V_{r1} is the so-called lower limit level, and V_{r2} is the so-called upper limit level. Namely, integrated voltages over V_{r2} cause issuance of an alarm indicating the occurrence of yarn breakage, while integrated voltages under V_{r1} cause cut-off of the alarm. This is the so-called hysteresis characteristic and prevents erroneous ter-

mination of the alarm by occurrence of the Valley P. Since the flip-flop 24-3 is set when the integrated voltage rises over V_{r2} and is reset when the integrated voltage drops under V_{r1} , the output of the flip-flop 24-3 becomes as illustrated in Fig. 6G and the alarm is maintained in spite of the occurrence of the Valley P (as illustrated in Fig. 6F). This alarm signal drives the alarm circuit 25 to activate an alarm device (not illustrated in drawings).

This method enables reliable transmission of an alarm without lengthening the response time for detecting yarn breakage.

(6) Some output or another always appears at point E of Fig. 5. This is because some floating fibers pass through the pneumatic duct even when there is no yarn breakage. Seen from another viewpoint, this means the absence of some output at point E would be abnormal. For example, cut-off of the lamp of the light projector in the pneumatic duct, disconnection of the wiring to point E, or other abnormalities may cause a drop in the voltage at point E. Detection of this type of abnormality is done by an abnormality detecting circuit 26, in which the voltage at point E is successively kept at a capacitor C_3. These circumstances are illustrated in Fig. 6H. If an abnormality occurs, the capacitor C_3 begins to discharge through a resistance R_5 , and its terminal voltage continues to fall with time constants C_3 and R_5. Therefore, detection of the falling voltage from the setting voltage V_{r3} enables determination of the occurrence of an abnormal condition. For this purpose, a comparator 26-1 having a reference voltage V_{r3} is provided to emit an output as illustrated in Fig. 6I during an abnormal condition. This drives an abnormality alarm device circuit 26-2 to activate an abnormality alarm device (not illustrated in drawings).

The apparatus of the present invention described with reference to Fig. 5 and Fig. 6A through 6I was arranged on eight spinning frames (400 spindle per frame, 14,200 rpm), in which a combed cotton yarn 40^s is spun, for inspection of its reliability by the following method. All spindles, i.e., 3,200 spindles, were watched between 9:00 an to 12:00 noon and between 12:40 pm to 3.40 pm at 20 minute intervals. Confirmation was made as to whether the alarm indicating lamps of the apparatus of the present invention went on when yarn breakage actually occurred and whether the alarm indicating lamps went off after repair of the yarn breakage by a piecing procedure. The number of erroneous operations was calculated. The reliability R is expressed by the following equation:

$$R = \{1 - n/mc\} \times 100\%$$

where,

n_1: Number of times lamps did not go on

n_2: Number of times lamps did not go off

n: Number of erroneous operations, i.e, n_1 plus n_2

c: Number of inspection periods

m: Number of alarm indicating lamps per frame (in this case, m = 2).

Table 1 shows the results of a reliability inspection conducted over four days, i.e., April 27, 28, and 29, 1981, and May 18, 1981. As clear from the table, the apparatus of the present invention having the electrical circuit illustrated in Fig. 5 was confirmed to have a very high reliability, i.e., from 95% to 98%.

CAPABILITY OF EXPLOITATION IN INDUSTRY

The apparatus of the present invention detects fibers floating in the pneumatic main duct by applying light to the fibers and detecting the light scattered by those fibers and emits an alarm via the above-mentioned electrical circuit. Therefore, there is absolutely no need to touch the yarn during spinning, and yarn breakage can be detected without any influence on the spinning conditions. Further, there is no need to arrange a detecting member on each spindle of the spinning frame or to arrange a moving unit for moving the detecting member in the space between spinning frames. Therefore, the apparatus of the present invention can be made at a lower cost compared with ordinary apparatuses. Furthermore, the apparatus of the present invention can be easily attached to existing spinning frames with a simple remodeling. Thus, the practical effect of the apparatus of the present invention is extremely high.

Table 1

	Date	April 27, 1982			April 28, 1982			April 29, 1982			May 18, 1982		
	Time / Item	n_1	n_2	n	n_1	n_2	n	n_1	n_2	n	n_1	n_2	n
1	9:00- 9:20	0	0	0	1	1	2	0	0	0	1	0	1
2	9:40	0	0	0	0	0	0	0	0	0	1	0	1
3	10:00	0	0	0	0	0	0	0	2	2	1	0	1
4	10:00-10:20	0	1	1	0	0	0	0	0	0	0	0	0
5	10:40	0	0	0	0	0	0	1	0	1	0	2	2
6	11:00	1	0	1	0	1	1	0	0	0	0	0	0
7	11:00-11:20	0	0	0	0	0	0	0	1	1	0	0	0
8	11:40	0	0	0	0	0	0	0	0	0	1	1	2
9	12:00	1	0	1	0	0	0	0	1	1	0	0	0
10	12:40-13:00	0	0	0	1	1	2	0	0	0	0	1	1
11	13:00-13:20	1	0	1	0	0	0	0	0	0	0	1	1
12	13:40	0	0	0	1	0	1	0	0	0	1	0	1
13	14:00	1	0	1	0	0	0	0	0	0	1	0	1
14	14:00-14:20	0	0	0	0	1	1	0	0	0	1	1	2
15	14:40	1	0	1	0	1	1	0	1	1	0	0	0
16	15:00	0	0	0	0	1	1	0	1	1	0	0	0
17	15:00-15:20	0	0	0	0	1	1	0	1	1	0	1	1
18	15:40	0	0	0	0	1	1	0	0	0	1	0	1
	Total	5	1	6	3	8	11	1	7	8	8	7	15
Reliability (R)			98%			96%			97%			95%	

CLAIMS

1. A method for detecting yarn breakage in a spinning frame which comprises projecting incident light into a pneumatic duct in a spinning frame, detecting photoelectrically the light scattered by floating fibers passing through said incident light and converting it into electric pulse signals, integrating these by predetermined time constants, and comparing them with a presetting value to detect abnormal values.

2. A method according to claim 1, wherein a direct current component is removed from said electric pulse signals and only an alternating current component is integrated by the predetermined time constants.

3. A method according to claim 2, wherein amplitudes of said electric pulse signals are equalized and unnecessary noise signals are removed before said alternating current component is integrated by the predetermined time constants.

4. A method according to claim 3, wherein a predetermined value is divided into a lower limit level and an upper limit level and an abnormal value between the time after an integrated voltage level of the electric pulse signals integrated by said predetermined time constants pass over said upper limit level and the time until the level falls below said lower limit level is successively detected.

5. A method according to claim 4, wherein electric pulse signals equalized in amplitude and free from unnecessary noise are integrated and, when the integrated level falls below the predetermined lower level, occurrence of abnormalities in a circuit network for detecting yarn breakage is detected.

6. An apparatus for detecting yarn breakage in a spinning frame, characterized in that said apparatus is comprised of a photocell detecting photoelectrically light scattered by floating fibers passing through incident light projected into a pneumatic duct in a

spinning frame, an amplification circuit amplifying electric pulse signals received from said photocell, an integration circuit integrating by predetermined time constants amplified electric pulse signals received from said amplification circuit, a first comparator circuit comparing an integrated voltage level of said integration circuit with a predetermined standard voltage level and outputting signals detecting an abnormal value when said integrated voltage passes over said standard voltage, and a yarn breakage alarm circuit driven by said abnormal value detecting signals received from said first comparator circuit.

7. An apparatus according to claim 6, wherein a capacitor removing a direct current component from electric pulse signals from said photocell and passing only an alternating current component is provided in an input portion of said amplification circuit.

8. An apparatus according to claim 7, wherein amplitudes of amplified electric pulse signals from said amplification circuit are equalized and unnecessary noise signals having a level lower than the predetermined standard voltage are removed by providing in the input portion of said integration circuit a second comparator circuit receiving said amplified electric pulse signals as a first input and receiving said predetermined standard voltage as a second input.

9. An apparatus according to claim 8, wherein said first comparator circuit is comprised of a pair of a first comparator and a second comparator and of a flip-flop using the outputs of said first comparator and said second comparator as a set input and a reset input, respectively, and, the first inputs of said first comparator and said second comparator receive commonly said integrated voltage from said integration circuit and their second inputs separately receive two predetermined standard voltages, i.e., a lower limit level and an upper limit level.

10. An apparatus for detecting yarn breakage in a spinning frame comprising a photocell detecting photoelectrically light scattered by floating fibers passing through incident light projected into a pneumatic duct in a spinning frame and outputting electric pulse signals, an amplification circuit amplifying electric pulse signals received from said photocell, an integration circuit integrating by predetermined time constants amplified electric pulse signals received from said amplification circuit, a first comparator circuit comparing an integrated voltage level of said integration circuit with a predetermined standard voltage level and outputting signals detecting an abnormal value when said integrated voltage passes over said standard voltage, a yarn breakage alarm circuit driven by said abnormal value detecting signals received from said first comparator circuit, and a second comparator circuit receiving said amplified electric pulse signals as a first input and the predetermined standard voltage as a second input to equalize amplitudes of said amplified electric pulse signals from said amplification circuit and to remove unnecessary noise signals having a level under the predetermined standard voltage and provided at the input portion of said integration circuit; characterized in that said apparatus is further provided with a circuit for detecting abnormalities comprising a charging capacitor successively charging output from said second comparator circuit, a discharging resistance connected in parallel to said charging capacitor, and a third comparator circuit receiving a charging voltage of said charging capacitor as a first input and receiving the predetermined lower level as a second input, occurrence of abnormalities in the circuit network for detecting yarn breakage being detected by detecting, by means of said third comparator circuit, that said charging voltage falls below said predetermined lower level.

Fig. 1

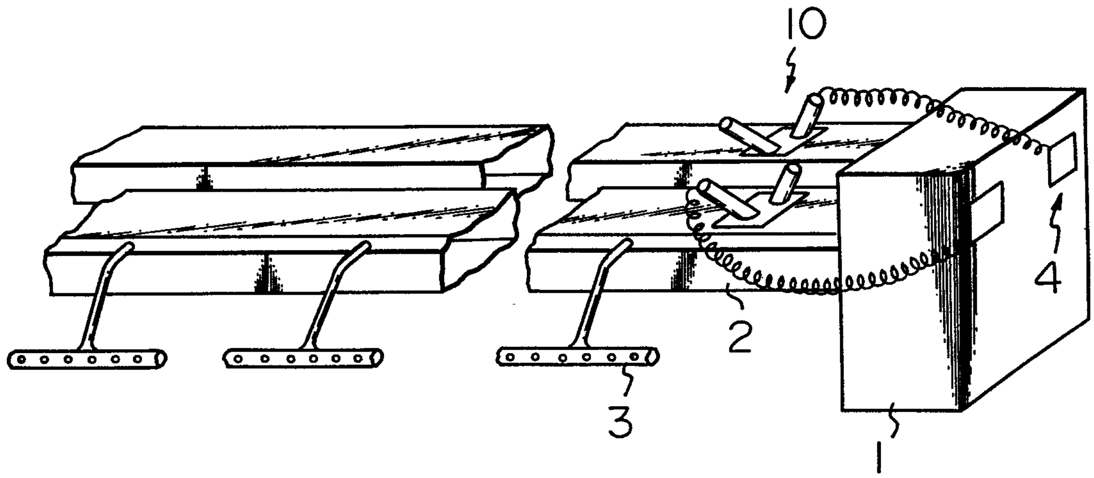


Fig. 2

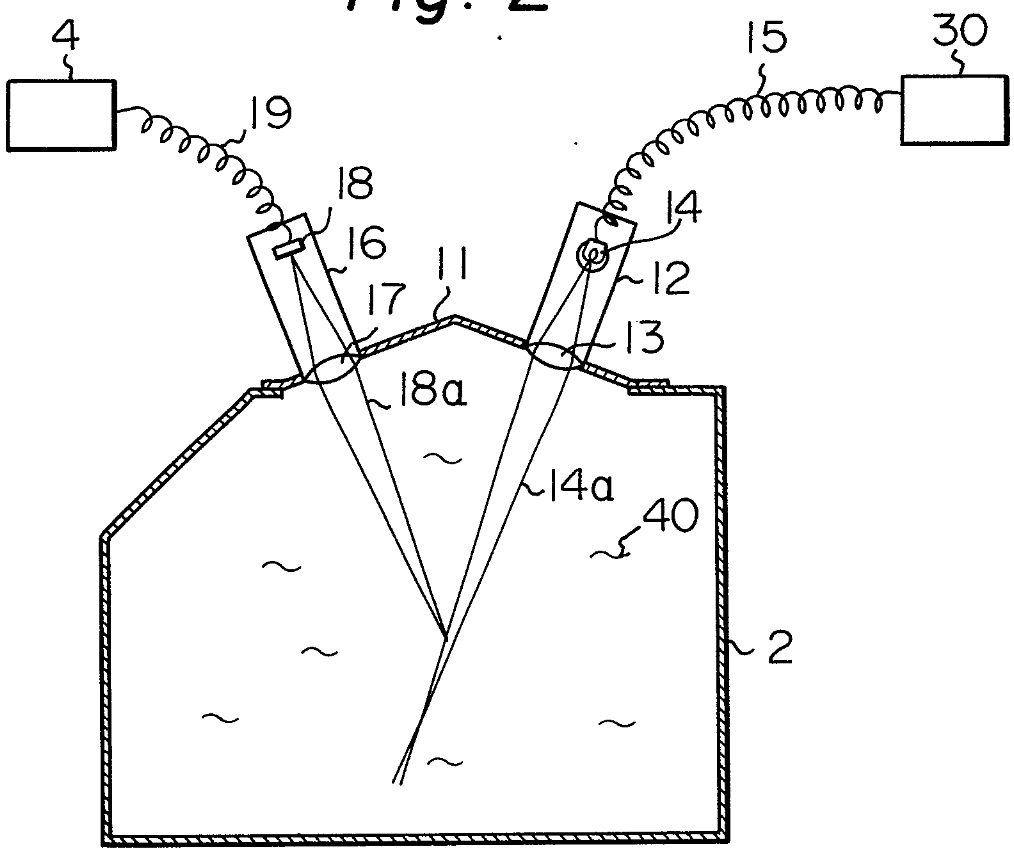


Fig. 3

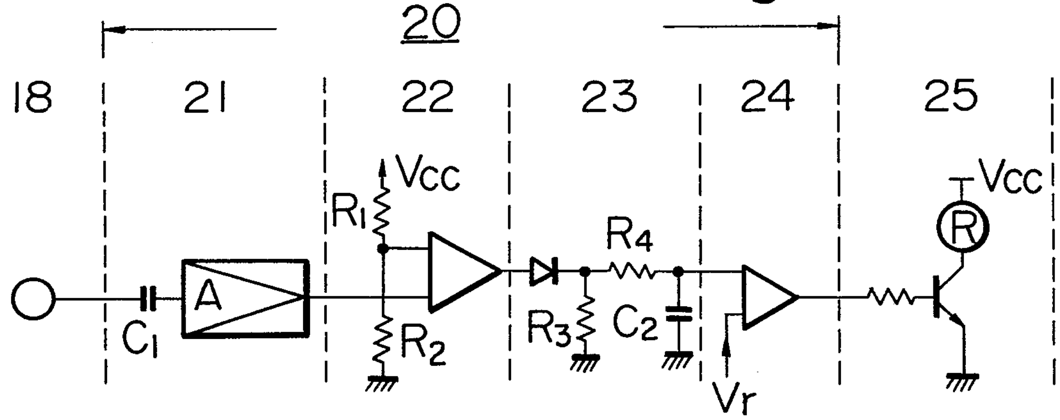


Fig. 4A

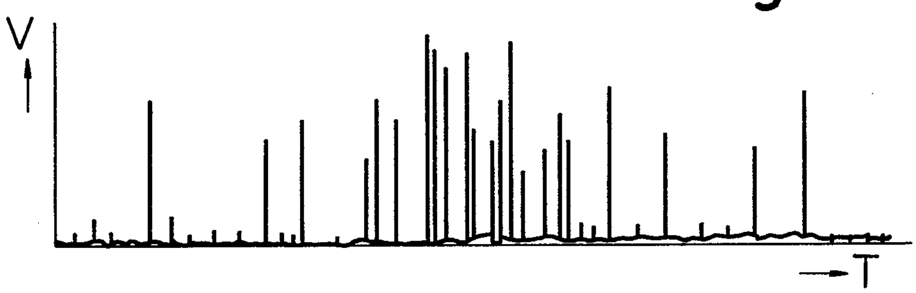


Fig. 4B

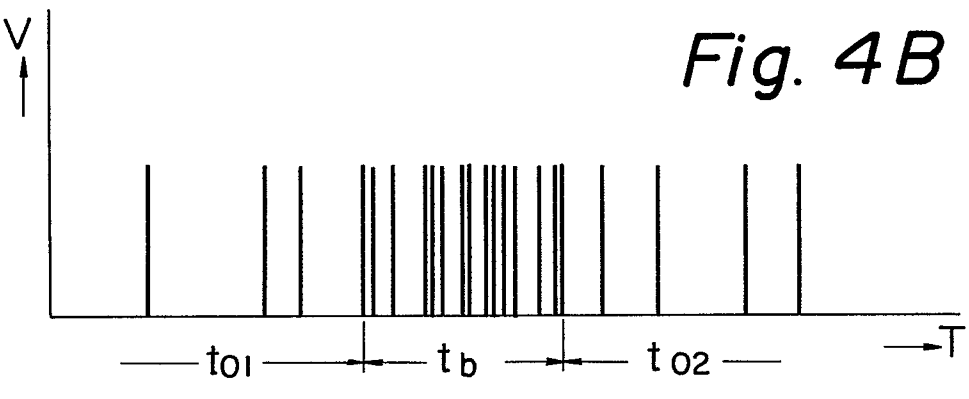


Fig. 4C

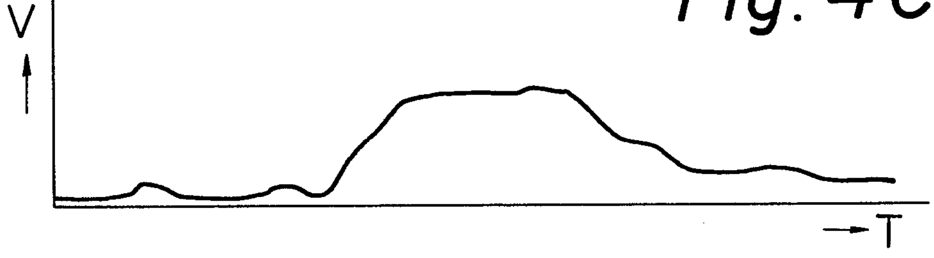
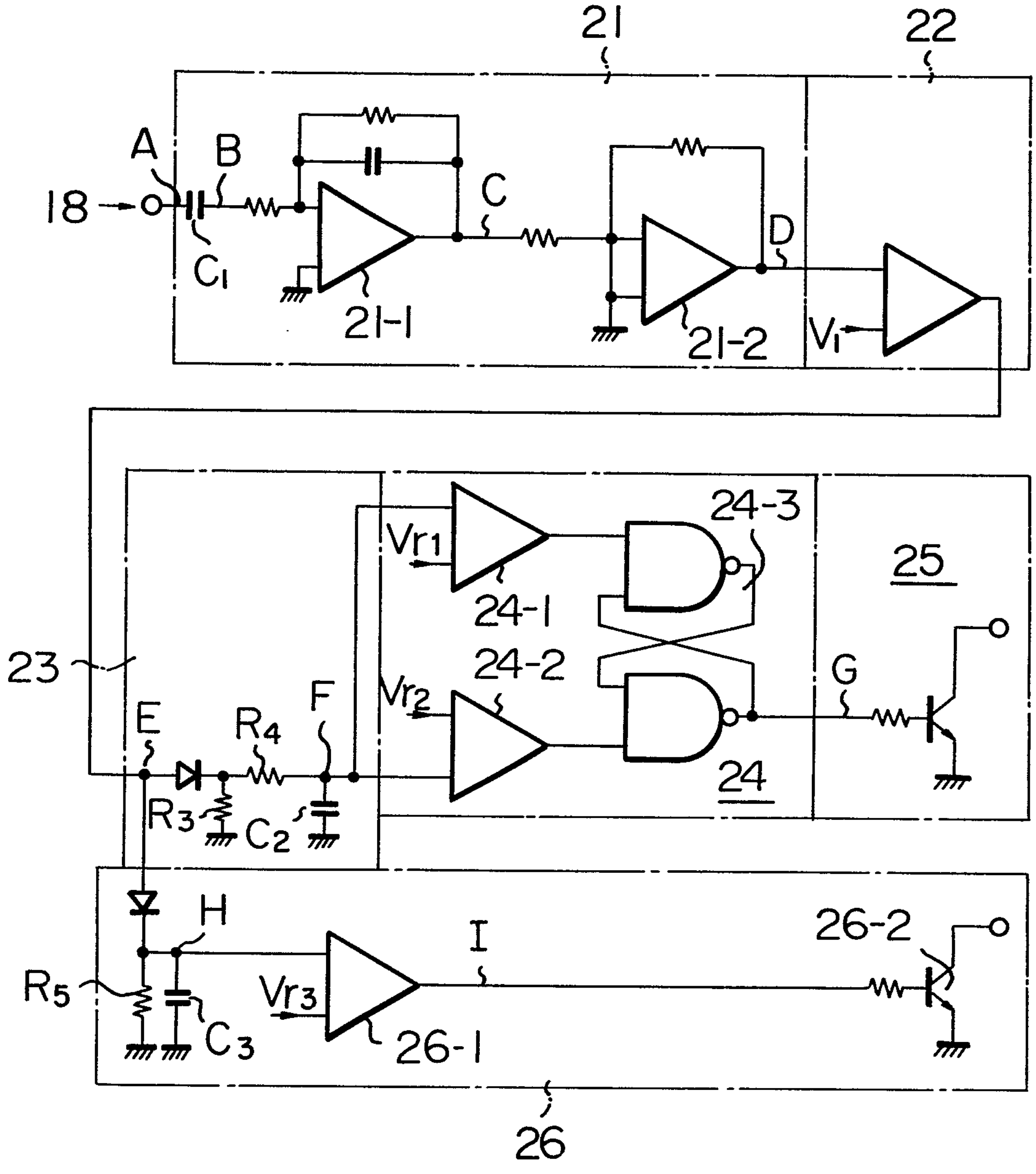


Fig. 5


21
22
A
B
18
C1
C
D
21-1
21-2
V1
24-3
25
Vr1
24-1
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23
Vr2
G
E
R4
F
24
R3
C2
H
I
26-2
R5
Vr3
C3
26-1
26

Fig. 6A

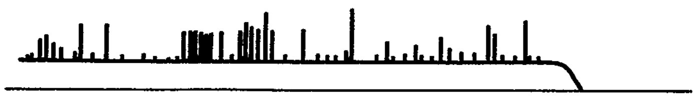

Fig. 6B

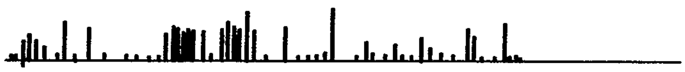

Fig. 6C

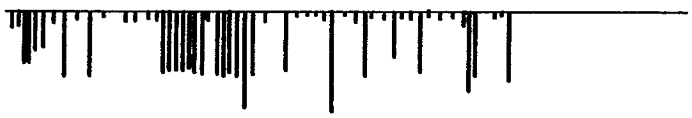

Fig. 6D

Fig. 6E

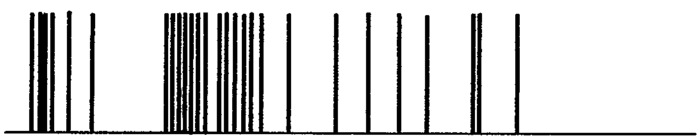

Fig. 6F

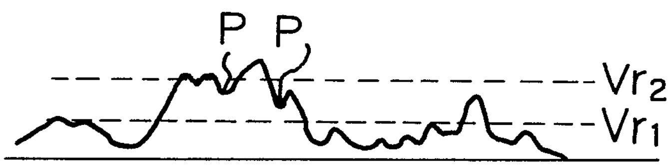

Fig. 6G

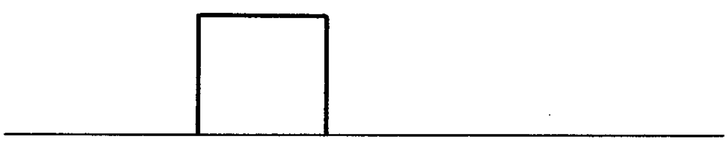

Fig. 6H

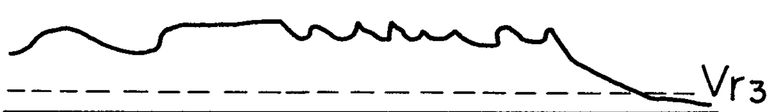

Fig. 6I

LIST OF REFERENCE NUMBERS AND MEMBERS

1 ... case accommodating pneumatic suction device
2 ... pneumatic duct
3 ... pneumatic flute
4 ... panel box
10 ... detecting unit
11 ... attaching member
12 ... light projector
13 ... light projection lens
14 ... light source
15 ... lead wire
16 ... light collector
17 ... light collecting lens
18 ... photocell
19 ... lead wire
20 ... amplification, comparison, and judgement circuit
21 ... amplification circuit
21-1 ... amplifier
21-2 ... buffer amplifier
22 ... comparator circuit
23 ... integration circuit
24 ... comparator circuit
24-1 ... comparator
24-2 ... comparator
24-3 ... flip-flop
25 ... alarm circuit
26 ... circuit for detecting abnormalities
26-1 ... comparator
26-2 ... abnormality alarm device circuit
30 ... electric source
40 ... fibers

INTERNATIONAL SEARCH REPORT

International Application No. PCT/JP 82/00294 0115537

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) [3]

According to International Patent Classification (IPC) or to both National Classification and IPC

D01H13/16

II. FIELDS SEARCHED

Minimum Documentation Searched [4]

Classification System	Classification Symbols
IPC	D01H 13/14, 13/16

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched [5]

III. DOCUMENTS CONSIDERED TO BE RELEVANT [14]

Category*	Citation of Document, [16] with indication, where appropriate, of the relevant passages [17]	Relevant to Claim No. [18]
X	JP, A, 57-77328 (Daiwa Spinning Co., Ltd. and two others) 14. May.1982 (14.5.82)	1-10
X	JP, A, 52-85528 (Shikibo Ltd.) 15.July.1977 (15.7.77)	1-10

* Special categories of cited documents: [15]

"A" document defining the general state of the art which is not considered to be of particular relevance

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"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search [2]	Date of Mailing of this International Search Report [2]
October 19, 1982 (19.10.82)	November 1, 1982 (01.11.82)

International Searching Authority [1]	Signature of Authorized Officer [20]
Japanese Patent Office	

Form PCT/ISA/210 (second sheet) (October 1981)