United States Patent [19]

Kamp et al.

[11] **3,801,031**

[45] **Apr. 2, 1974**

[54] **METHOD AND APPARATUS FOR MONITORING THROW-OFF LOOP FORMATION ON THE YARN GUIDING DRUM OF COIL WINDING MACHINES**

[76] Inventors: **Heinz Kamp**, Schwalmstr. 5, Rickelrath; **Walter Gith,** Franziskanerstr. 12, Monchengladbach, both of Germany

[22] Filed: **Oct. 26, 1971**

[21] Appl. No.: **192,509**

[30] **Foreign Application Priority Data**

Oct. 23, 1970 Germany 2052117

[52] **U.S. Cl.** .... **242/36,** 242/49, 250/219 R

[51] **Int. Cl.** **B65h 63/02**

[58] **Field of Search** .... 242/36, 37, 28, 43, 49, 242/35.5 R, 35.6 R; 250/219 S, 219 R

[56] **References Cited**

UNITED STATES PATENTS

3,592,400 7/1971 Gith 242/36

Primary Examiner—Stanley N. Gilreath

Attorney, Agent, or Firm—Herbert L. Lerner

[57] **ABSTRACT**

Method of monitoring the operation of a yarn winding machine having a yarn receiving coil and a drum for guiding the yarn onto said coil, said yarn having a predetermined reciprocating traverse stroke range, consists of the steps of monitoring the range of said traverse stroke, and interrupting the yarn winding operation in response to a range of the traverse stroke which falls short of said predetermined range, and device for carrying out the method.

12 Claims, 12 Drawing Figures

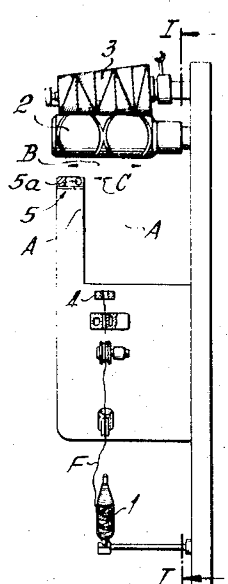


FIG.1

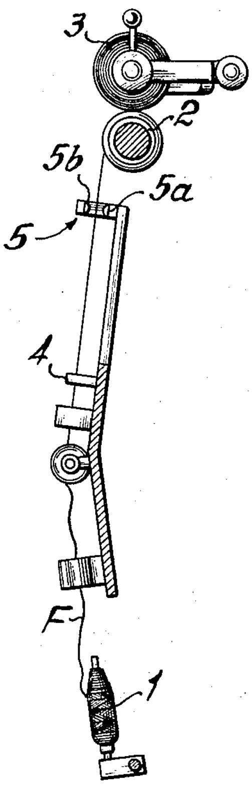


FIG.2

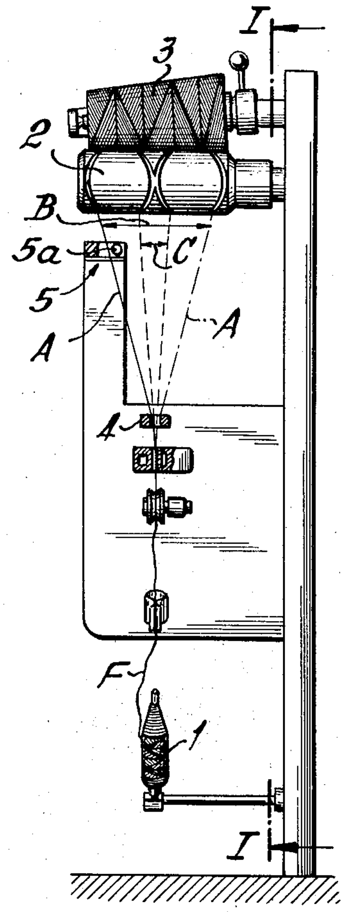


FIG.3

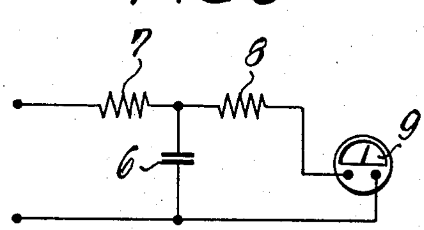


FIG.4

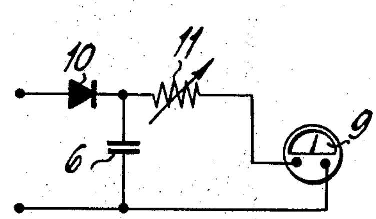


FIG. 5

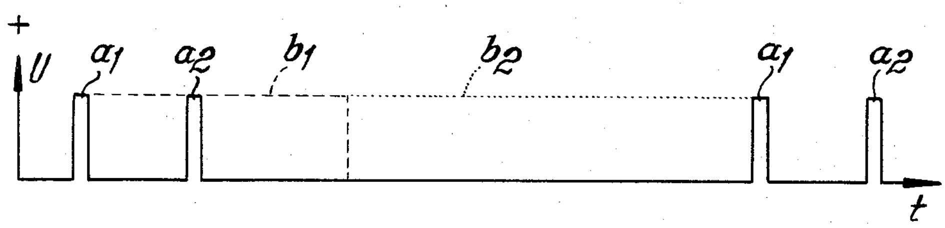
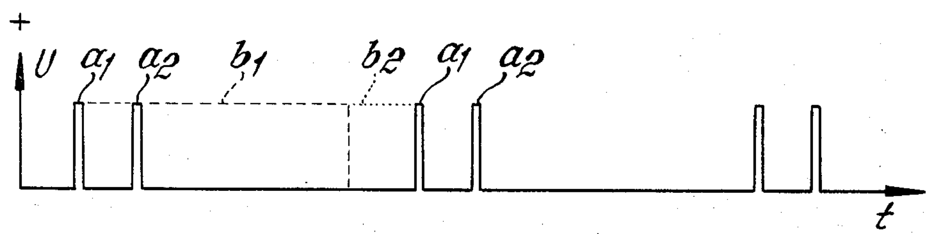


FIG. 6



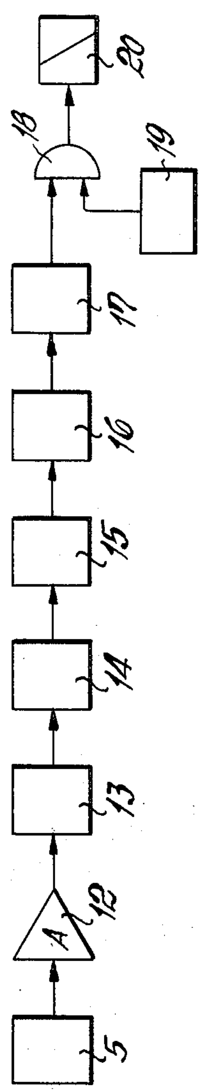

5
A
12
13
14
15
16
17
18
19
20

FIG.7

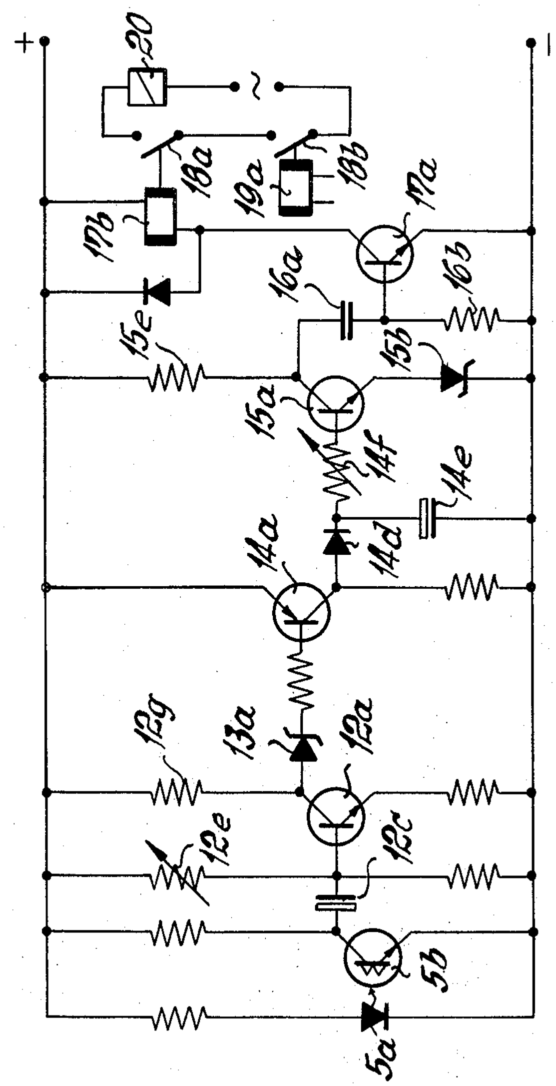

+
20
~
18a
19a
18b
17a
17b
15e
16a
16b
15b
15a
14f
14e
14a
14d
12g
13a
12a
12e
12c
5b
5a

FIG.8

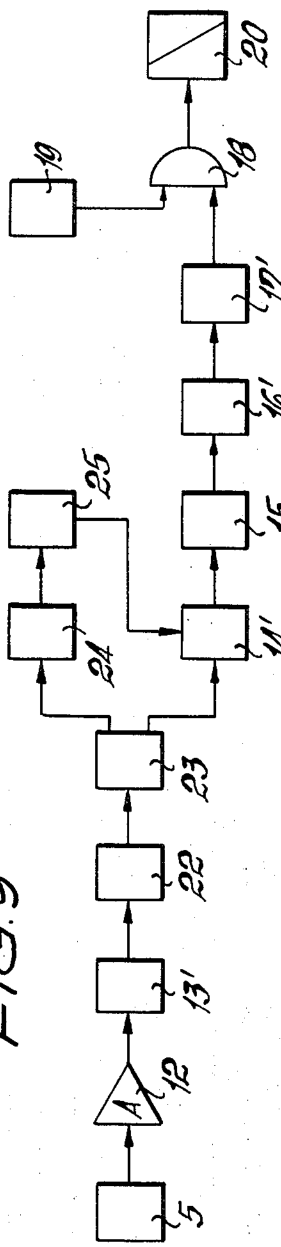


FIG. 9

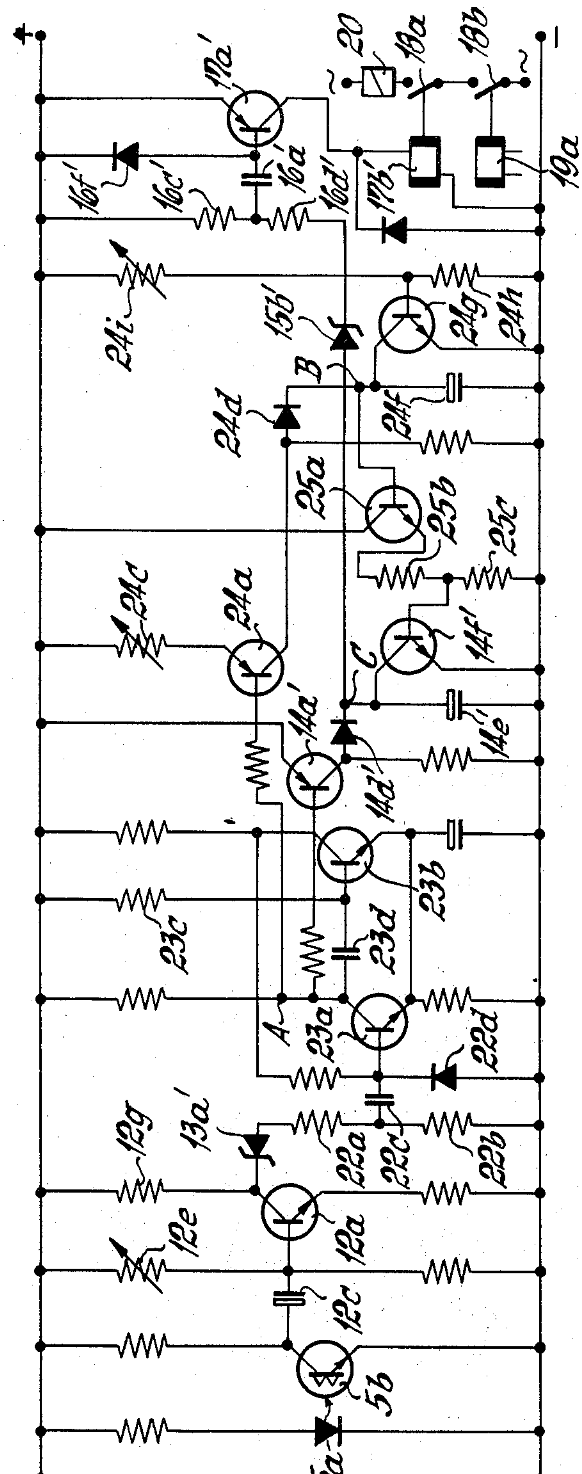


FIG. 10

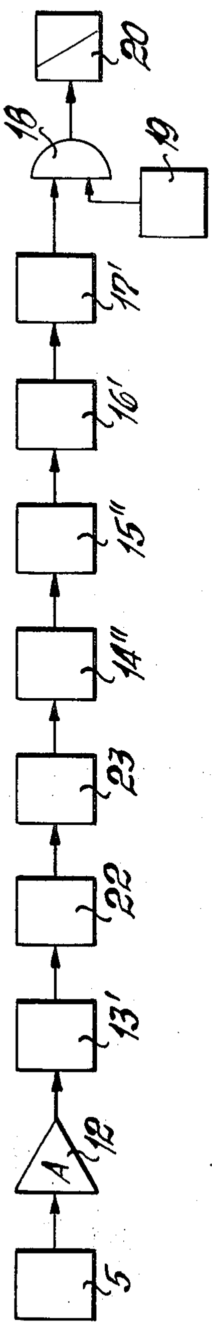

5
A
12
13'
22
23
14''
15''
16'
17'
18
19
20

FIG. 11

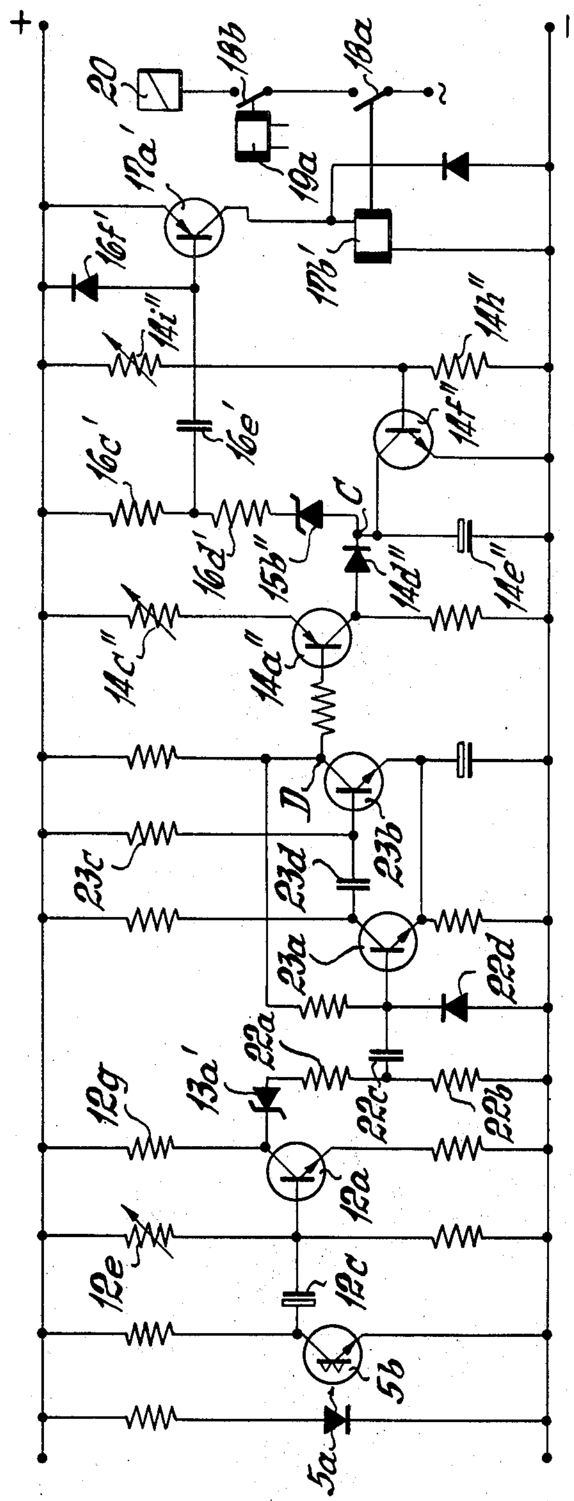

+
-
20
18b
18a
19a
17a'
17b'
16f'
14i''
14h''
16c'
16e'
14f''
C
16d'
15b''
14d''
14e''
14c''
14a''
D
23b
23c
23d
23a
22d
22a
13a'
22c
22b
12g
12a
12e
12c
5b
5a

FIG. 12

METHOD AND APPARATUS FOR MONITORING THROW-OFF LOOP FORMATION ON THE YARN GUIDING DRUM OF COIL WINDING MACHINES

The invention relates to a method for monitoring throw-off loop formation on the yarn guiding drum of winding machines and to apparatus for carrying out this method.

In using winding machines having a yarn guiding drum effecting a reciprocating traverse motion of the yarn for the winding operation, it may happen that a throw-off loop is formed on the yarn guiding drum after a break of the yarn, since the very short-term interruption of the winding operation has gone unnoticed by the yarn monitor. Such throw-off drum loops represent a danger for the winding machine as the size of the loops increases. For the purpose of monitoring such throw-off drum loops, it has been known to provide a mechanical sensing element in close proximity to the yarn guiding drum which is actuated by the loop while it is being formed and which acts to stop the winding operation.

In order to make it possible to effect such a stoppage as early as possible, it is necessary, however, that the sensor be disposed very closely to the yarn guiding drum, which may easily lead to injury of the guiding drum. Proposals to use non-contact making sensing elements in place of mechanical sensors, such as light barriers and the like, did not result in the necessary safety, since, due to disturbing factors, these sensors either acted to effect the stoppage when a throw-off loop was not present, or the stoppage took place only when the throw-off loop had reached a relatively large size.

It is an object of the invention to provide a method of monitoring throw-off loop formation on a yarn guiding drum which does not have the above-mentioned disadvantages.

With the foregoing and other objects is view, in accordance with the method of the invention, the extent of traverse motion of the yarn is monitored, and the winding operation is interrupted whenever the nominal stroke distance of traverse travel falls short. Thus, when a throw-off loop occurs, the width of the traverse is narrowed, since the yarn can not longer be guided any more by the grooves of the yarn guiding drum to the lateral reversing points. It is accordingly possible, for the purpose of carrying out the method in accordance with the invention, to provide within the extent of the traverse, one or more sensing elements responsive to the traversing yarn which act to control the stoppage of the winding machine. During the regular winding operation, the sensing elements are periodically and equally acted upon during each of the yarn traverses. Should a throw-off drum looping occur, however, such a control of the sensing elements does not take place or only occurs in limited form. The stoppage device of the winding machine may then be actuated by means of a suitable control mechanism.

Particularly with winding machines operating with high yarn velocities, it is possible that yarn misguidance may take place due to the fact that the yarn briefly leaves the yarn guiding grooves. Thereby, the extent of the traverse stroke is also briefly diminished without a throw-off loop formation having taken place. After a short period, the yarn is recaptured by the yarn guiding grooves and is then reciprocated back and forth methodically so that this yarn misguidance has no injurious effect on the winding operation.

In order to prevent such yarn misguidance also from leading to an interruption of the winding operation, according to a further feature of the method of the invention, the winding operation is interrupted only after the desired value of the stroke of the traverse has fallen short repeatedly. Apparatus particularly suitable for carrying out this method comprises a stoppage device for the winding machine which is controlled by an amplifier including an integrating stage for the pulses generated by the sensing element in response to the traversing yarn. Regardless of whether these impulses are characterized by variable power, as for instance variable amplitude or variable duration, or by such which comprise individual successive energy impulses separated by intervals therebetween, the falling-short of a prescribed required value of the output signal of the integrating stage indicates that the required value of the transverse stroke has fallen short inadmissably too frequently. Thus, a criterion will have been established for the occurrence of a drum throw-off loop.

The duration of the pulse variations, or the distance with respect to time of individual pulses increases as the winding velocity decreases. In order to compensate for this effect of the winding velocity on the integration of the impulses derived from the sensing elements, the time constant of the integration stage may be made variable as a function of the winding velocity. In view of the fact that changes in the winding velocity in general are determined by changes in the yarn material to be wound, and which in any case require various adjustments at the winding stations, the changes of the time constants of the integration stage as a function of the winding velocity may be carried out by hand. In the case of overall automation, an automatic change of the time constant of the integration stage may be obtained by utilizing the relationship between the pulse sequence derived from the yarn and of the constant pulse sequence of a time element, such as the relaxation period of a monostable multivibrator actuated by the yarn-derived pulses.

In order to compensate for the effect of the winding velocity on the pulses produced by the sensing elements, a change in the time constant of the integration stage may, however, by unnecessary. This is made possible when, in accordance with a further feature of the invention, the energy storage device contained in the integration stage is charged from a constant current source and is discharged through a constant current load, wherein the constant current source is controlled by pulses inversely proportional to the yarn velocity. By having the energy storage device on charge from a constant current source and discharged into a constant current load, the energy storage device will display a linear characteristic for charge as well as for discharge.

If the energy storage device is being charged proportionately to the yarn velocity, the linear characteristic of the charging and discharging circuit assures that the charge in the energy storage device is made proportional to the yarn velocity. Since, for instance, with lower yarn velocity, the intervals between pulses are greater, it is desirable that the stored energy by greater with lower yarn velocity. This result is achieved by controlling the constant current source by pulses which are inversely proportional to the yarn velocity. For instance, a monostable multivibrator actuated by yarn pulses may serve to produce such pulses which are inversely proportional to the yarn velocity.

It will be understood that monitoring of drum throw-off loops will be effective only as long as the yarn moves in the direction of the yarn guiding drum since otherwise with each stoppage of the yarn there would appear to be a drum throw-off loop formation. In such a case it would mean, with automatic winding machines having automatic retying of broken yarn ends that, after a yarn break, the device for retying the yarn at this winding station cannot come into operation. In order to avoid this disadvantage, it is therefore desirable to include a logic tie between the amplifier and the stoppage arrangement of the winding machine, which is connected to a signal generator indicating the motion of the yarn. If, for instance, the signal generator provides a signal only for the moving yarn, an AND - link may be included in the circuit. In such a case, the stopping arrangement for the winding machine will be actuated by the drum throw-off loop monitor only when the yarn is moving in the direction of the yarn guiding drum.

It is possible that when the stoppage of the winding machine has occurred as a result of a completed receiver-coil winding, the traverse motion of the yarn is accidentally interrupted just when the yarn acts on a sensing element. Difficulties for the control function due to the above circumstances may be eliminated in a particularly simple manner: Impulses derived from the sensing elements are applied only dynamically to the amplifying arrangement, which is to say that only changes in the impulses derived from the sensing elements are made to control the amplifier arrangement.

The foregoing and more specific objects, advantages, and features of the invention will be apparent from the following description in conjunction with the embodiments of devices according to the invention illustrated by way of example in the accompanying drawings, in which:

FIGS. **1** and **2** are schematic side and front elevational views of the construction of a yarn winding station;

FIG. **3** is a diagram of an intergration circuit;

FIG. **4** is a diagram of another form of integration circuit adapted for use with various yarn thicknesses.

FIG. **5** is a voltage-time curve of voltage pulses derived from yarn travelling at a given speed, and

FIG. **6** is a similar curve of pulses for yarn travelling at double the speed of that shown in FIG. **5**;

FIG. **7** is a block diagram of a yarn winding monitoring circuit in accordance with the invention, and

FIG. **8** is a detailed circuit diagram of the circuit of FIG. **7**;

FIGS. **9** and **10** are a block diagram and detailed circuit diagram, respectively, of a yarn winding monitoring circuit including a device for automatic adjustment of the integration time constant; and

FIGS. **11** and **12** are block and circuit diagrams, respectively, of another form of yarn winding monitoring circuit including facilities for adjusting the integration function to yarn winding velocity.

From the schematically illustrated construction of a yarn winding station in FIGS. **1** and **2**, there is seen that the yarn F, originating from the supply winding **1**, is guided through various elements of the winding machine and is eventually wound upon the cross-wound coil or cheese **3** with the aid of the yarn winding drum **2**. FIG. **2** shows how the yarn between the last guiding element **4** and the yarn guiding drum **2** reciprocates over a triangular surface here indicated as the traverse area A. To one side of the traverse area A there is provided a sensing member **5** consisting of a light barrier. This sensing member **5** is controlled by the yarn F as it traverses the full extent of the reciprocating stroke B, in that the ray of light emitted by the lamp **5***a* toward the light sensitive element **5***b* is interrupted by each yarn passage or is at least attenuated thereby. A pulse sequence is thus generated as is shown in FIG. **5**. For each traverse motion from right to left, as in FIG. **2**, the passage of the yarn through the ray of light generates a signal a_1. A signal a_2 is produced as a result of the return of the thread.

Upon the occurrence of a drum throw-off loop, the yarn reciprocates, for example, through a traverse stroke indicated at C in FIG. **2**. Since in this case, the light barrier **5** is not affected, the regular impulse sequence of FIG. **5** is interrupted. In order to utilize this interruption of the impulse sequence for the purpose of stopping the winding machine, the stoppage device for the winding machine may be controlled by means of an amplifier which includes an integrating circuit as shown in FIG. **3**. As long as the pulses are present, that is, during a normal winding operation, condenser **6** is being charged as a function of the frequency over resistance **7**. Should the pulses fail to occur, the condenser **6** discharges through resistance **8** and a measuring or control device schematically shown at **9**. If this measuring or control device **9** takes the form of a zero potential indicator, a release magnet may be controlled as a consequence of the decrease of the potential of condenser **6** to under a predetermined value so as to act to stop the winding drive. The time constant of the condenser discharge which is determined by resistance **8** may be so chosen that the stoppage of the winding drive takes place only after a repeated absence of the pulse sequence.

A disadvantage of the embodiment shown in FIG. **3** is that the time dependent charge of condenser **6** will result in different condenser charges due to different yarn thicknesses, since the pulse width is a function of the yarn thickness. Thus, the period of discharge of condenser **6** through resistance **8** is also made dependent on the yarn thickness. In order to avoid this disadvantage, as shown in FIG. **4**, condenser **6** may be charged through a diode **10** so fast and practically without delay that the pulse width loses its significance.

Assuming that the pulse sequence of FIG. **5** represents a yarn winding velocity of 600 m/min., then FIG. **6** would indicate the pulse sequence for double the velocity, that is, for 1,200 m/min. It will be seen therefrom that the condenser **6** of FIG. **4** is being charged up through the pulse sequence in accordance with FIG. **6** twice as frequently as by the pulse sequence according to FIG. **5**. As mentioned above, it is undesirable that the measuring and control device **9** should respond each time when the pulse sequence is absent. If, for instance, the discharge period of condenser **6** has been adjusted in such a manner that the winding drive is stopped only after the third absence of the pulse sequence, as in FIG. **5**, this would mean that with the velocity according to FIG. **6**, the winding drive would be affected only after the sixth interruption of the pulse sequence. In order to eliminate this disadvantage it becomes advantageous to conform the time constant of the integrating circuit to the winding velocity. Accordingly, in the embodiment of FIG. 4 the resistance **11** has been shown as being adjustable.

FIGS. **7** and **8** represent a simple embodiment of a circuit arrangement for use with the invention, FIG. **7** illustrating a simplified block diagram for the circuit of FIG. **8.**

The sensing organ **5** for the traversing yarn consisting of a light barrier utilizes a gallium-arsenide diode as a light source **5***a* and a phototransistor as a light sensitive element **5***b*. The succeeding amplifier stage **12** forms part of the amplifier system **12** through **17** which serves to control the stoppage device **20** of the winding machine. Amplifier stage **12** is coupled to the circuit of the phototransistor **5***b* by way of the condenser **12***c* whereby the d. c. component of the phototransistor is blocked, the pulses derived from the sensing member thus being applied only dynamically to the amplifier arrangement. The operating level of the transistor **12***a* is so fixed by means of adjusting resistance **12e** that the said transistor is almost blocked causing thereby only a very small potential drop across its load resistance **12***g*. The significance of this arrangement is that the collector current, due to the pulses produced at the phototransistor **5***b*, caused by the traversing yarn, is not decreased to any practical extent, but in fact may be raised to its full amplitude. We are dealing here, therefore, with a so-called unidirectionally acting a. c. potential amplifier which can only be controlled by the pulse potentials produced during the momentary period of dimming of the phototransistor **5***b*. This unidirectional operating level makes possible the use of a simple Zener diode **13***a* as a threshold switch **13.**

In the succeeding ingegrating stage **14,** which includes the integrating circuit as in FIG. **4,** condenser **14**e is instantly charged up from transistor **14***a* over the diode **14***d*. The time constant of the integrating stage is adjusted by means of the resistance **14***f* so that the discharge current of the condenser **14***e* through the transistor **15***a* of the succeeding threshold switch **15** falls below the threshold potential of the Zener diode **15***b* only when the pulse sequence fails to appear with sufficient frequency. The control current of transistor **15** will also at that time be interrupted, the transistor **15***a* is blocked and the collector current through the resistance **15***c* is interrupted, so that the potential drop across this resistance is also collapsed. As a consequence there occurs a sudden positive going current pulse in the differentiating circuit **16** comprising condenser **16***a* and resistance **16***b*. Thus, the transistor **17***a* of the terminating switch stage **17** receives a control current pulse having a precisely limited length whereby transistor **17***a* actuates relay **17***b*. Contact **18***a* of the "AND" stage **18** thereby moves into the circuit-closing position. It will be seen that magnet **20** serving as a stoppage device and as a disconnect for the winding drive may be energized only at the time when contact **18***b* is in circuit closing position. This contact **18***b* of the "AND" stage **18** may be controlled by means of the magnet **19***a* of a signal generator **19** which indicates the motion of the yarn and which may for instance comprise an electronic yarn monitor.

In the embodiment described above according to FIGS. **7** and **8,** the matching of the time constant of the integrating stage **14** to the winding velocity is effected through manual adjustment of resistance **14***f*. An embodiment containing automatic adjustment of the time constant of the integrating stage as a function of the winding velocity has been illustrated in FIGS. **9** and **10,** wherein FIG. **9** is the block diagram for the schematic of FIG. **10.**

In the embodiment of FIGS. **9** and **10,** there is again provided a sensing element **5** including the gallium-arsenide diode **5***a* and the phototransistor **5***b* to which the amplifier **12** is connected through the condenser **12***c* including the transistor **12***a*. In the present example, however, the operating level of the transistor **12***a* has been adjusted by means of the resistance **12***e* unidirectionally in the reverse sense. Thus, transistor **12***a* is normally fully conductive so that the potential drop of the load resistance **12***a*, due to the high collector current, closely corresponds to the full battery potential at the ± input terminals. Since transistor **12***a* under these circumstances cannot be made more conductive, the control pulses appearing across condenser **12**c can only act to weaken the collector current of the transistor **12**a. While in the embodiment according to FIGS. **7** and **8** the darkening of the photoransistor **5***b* was the cause of the switching operation, the transistor **12***a* in the present instance will be switched as a consequence of the re-brightening of the phototransistor **5***b* following the yarn passage. Following the weakening of the collector current of transistor **12***a*, there occurs a drop in the potential of the load resistance **12***g* and the collector potential thereby becomes more positive. As a result, the potential threshold of the succeeding Zener diode **13***a'* of the threshold switch **13'** may be exceeded and a peak potential may be generated in the following differentiating circuit **22** comprising resistances **22***a* and **22***b* as well as the condenser **22***c* and diode **22***d*. This peak potential acts to trip the monostable multivibrator **23** whereby transistor **23***a* becomes conductive and the transistor **23***b* is blocked. The relaxation period of the monostable multivibrator and of the condenser **23***d*. This relaxation period remains constant.

As explained hereinbelow with reference to FIGS. **5** and **6,** the constant relaxation period of multivibrator **23** may serve as a magnitude standard for the yarn velocity. The constant relaxation period of the multivibrator is represented by the broken line b_1 in both of the Figures. It will be seen that the constant relaxation period b_1 of the multivibrator in the case of the rapid pulse sequence of FIG. **6** takes up about 80 percent of the pulse sequence period as defined by the broken line and the succeeding dotted line b_2. The constant relaxation period b_1 of the multivibrator for the slow pulse sequence as in FIG. **5** takes up only about 40 percent of the overall pulse sequence period $b_1 + b_2$. Accordingly, there is obtained from the pulse sequence $b_1 + b_2$, as derived from the yarn and the constant relaxation period b_1 of the monostable multivibrator, a standard magnitude which as will be described hereinbelow may serve as a basis for the automatic adjustment of the time constant of the integrating circuit.

An integrating stage **23** is connected to point A of the monostable multivibrator **23** wherein the condenser **24***f* is charged up through the transistor **24***a* and diode **24***d*. A negative feedback resistance **24***c* is connected to transistor **24***a* which serves to determine the magnitude of the time constant for charging condenser **24***f*. It is accordingly possible to so adjust resistance **24***c* that the condenser **24***f* will be charged up only over a suitably predetermined period. Thus, condenser **24***f* develops a potential which is proportional to the yarn velocity. A transistor **24***g* serves as a constant current load for the condenser **24***f* since the control current through resistors **24***i* and **24***h* is constant. As a result, the transistor **24***g* has the effect that the charge of condenser **24***f* leaks off independently of the potential. Thus, the potential amplitude of the condenser **24***f* remains proportional to the yarn velocity. The potential of the condenser **24***f* at point B is applied to an impedance transformer **25** comprising transistor **25***a*, representing only a small load at point B. A fractional potential may be obtained for the control of the transistor **14***f* ' from the potential divider **25***b* and **25***c*. Integrating stage **14**' is also connected to point A of the monostable multivibrator **23**, which functionally corresponds to the storage stage **14** in FIGS. **7** and **8**. Here, condenser **14***e*' is also instantly charged over transistor **14***a*' and diode **14***d*'. In place of the adjustable resistance **14***f* of FIG. **8** there has been provided a transistor **14***f*' which, in accordance with the description hereinabove, is controlled proportionately to the yarn velocity. Thus, the transistor **14***f*' controls the discharge velocity of the condenser **14***e*' so that the condenser **14***e*' discharges in proportion to the yarn velocity.

The potential of the condenser **14***e*' is supplied to the differentiating circuit **16**' by way of the threshold switch **15**' now comprising only a Zener diode **15***b*'. The differentiating circuit **16**' in this case contains, in addition to the condenser **16***a*', also resistors **16***c*' and **16***d*' as well as diode **16***f*'. This differentiating circuit again acts to control transistor **17***a*' of the terminating switching stage **17**', the transistor serving to control relay **17***b*' as shown in FIG. **11**. The termination of the circuit corresponds to that of FIG. **11**.

A further, particularly simplified solution for the automatic adjustment of the integration circuit with respect to the yarn velocity is shown in FIGS. **11** and **12**.

The condenser of the integrating circuit, as shown both in the embodiment of FIGS. **7** and **8** as well as that of FIGS. **9** and **10** had been charged instantly over a diode as in FIG. **4**. As already explained, the condenser charge thereby became dependent upon the pulse width and, thus, upon the yarn thickness. If, however, the relationship of the pulse sequence derived from the yarn and that of the constant pulse sequence of the timing circuit such as the relaxation period of the monostable multivibrator according to FIGS. **9** and **10** are used for the purpose of achieving an automatic adjustment of the time constant of the integrating circuit, the pulse width is no longer significant since the potential increase of the respective first pulse a_1 of a pulse sequence is the determining factor. It has already been explained with reference to FIGS. **5** and **6** how the constant relaxation period of the multivibrator **23** may serve as a comparison standard for the yarn velocity. It was shown that for the rapid pulse sequence according to FIG. **6**, the constant relaxation period of the multivibrator takes up about 80 percent of the pulse sequence period, whereas it takes up only about 40 percent for the slow pulse sequence according to FIG. **5**. It could already be seen from this consideration that the time reference point was given by the instant of the potential increase respectively of the first pulse a_1 of a pulse sequence. It becomes apparent therefore that the pulse width has lost its significance under these circumstances. Thus, it is no longer necessary for the automatic matching of the integrating circuit to the winding velocity, in accordance with the embodiment shown in FIGS. **9** and **10**, to adjust the discharge period of the condenser **14***e*'. Instead, the charging up of the condenser may be controlled as a function of the winding velocity.

Looking again at FIGS. **5** and **6**, it is seen that for the high velocity in FIG. **6**, line b_2 makes up only 20 percent, while for the low velocity in FIG. **5** in contrast thereto, it takes up only 60 percent of the distance of the pulse pairs. Period b_2 is thus inversely proportional to the yarn velocity. This fact, as shown in the embodiment of FIGS. **11** and **12**, may be utilized in such a manner that the integrating stage **14**'' is no longer connected to point A of the monostable multivibrator as in FIG. **10** but rather to point D. Thus, we obtain the reverse condition as described hereinabove wherein the desire for inverse proportionality for higher and lower base velocities is achieved directly while avoiding the additional storage stage **24** and the impedance transformer **25** as shown in the embodiment of FIGS. **9** and **10**.

The embodiment shown in FIGS. **11** and **12**, up to the monostable multivibrator **23**, is the same as that shown in FIGS. **9** and **10**. The integrating stage **14**'', however, is now connected at point D to the collector potential of transistor **23***b*. This collector potential acts to control the transistor **14***a*'' which serves as a constant current source. Due to the adjustable resistance **14***c*'', the transistor **14***a*'' charges the condenser **14***e*'' over the diode **14***d*'' no longer instantly but rather linearly and inversely proportional to the yarn velocity. Transistor **14***f*'' comprises a constant current load for the condenser **14***e*'', since the control current of the transistor **14***f*'' is held constant by resistance **14***i*'' and **14***h*''. As a consequence, the transistor **14***f*'' functions such that the charge of condenser **14***e*'' leaks off independently of its potential, that is to say, linearly. The potential amplitude of condenser **14***e*'' thus remains inversely proportional to the yarn velocity in spite of further charging pulses. The potential of condenser **14***e*'' being inversely proportional to the yarn velocity may be taken off at point C and applied to the differentiating circuit **16**' through Zener diode **15***b* '' which serves as a threshold switch **15**''.

The Zener diode **15***b*'' is so connected that for the higher charge potential of the condenser **14***e*'', that is, for lower yarn velocity, a longer discharge period will be required for attaining the switching threshold of Zener diode **15***b*'' as compared to a lower charge potential. The differentiating circuit **16**'' as well as the succeeding circuits **17**', **18**, **19** and **20** correspond in their structure to those of FIGS. **9** and **10**.

Although the invention is illustrated and described herein as embodied in method and apparatus for monitoring throw-off loop formation on the yarn guiding drum of coil winding machines, it is nevertheless not intended to be limited to the details shown, since various modifications and structural changes may be made therein without departing from the spirit of the invention and within the scope and range of equivalents of the claims.

Apart from the especially advantageous embodiments illustrated in the drawings of the present invention, further different possibilities may be used as mentioned hereinbefore in the description of the circuit diagrams for individual cases. It is further possible to use, in place of the sensing elements described in the exemplified embodiments, for one or both sides of the traverse area, other kinds of sensing elements. These may take a form similar to known capacitive yarn monitors or other types of light barriers. Thus, for example, the light barrier arrangement may be used for monitoring the size of the traverse stroke. Furthermore, sensing elements which utilize the tribo-electric principle may also be applied wherein for instance in a particularly simple case a pin or the like is disposed at the points of reversal in the drum and is contcted by the yarn.

We claim:

1. Method of monitoring the operation of a yarn winding machine having a yarn receiving coil and a drum for guiding the yarn onto said coil, said yarn having a predetermined reciprocating traverse stroke range, which comprises the steps of monitoring the range of said traverse stroke, and interrupting the yarn winding operation in response to a repeated falling short of said predetermined range.

2. Apparatus for monitoring the operation of a yarn winding machine having a yarn receiving coil and a yarn guiding drum for the receiving coil located adjacent thereto, the guiding drum having means for guiding the yarn onto the receiving coil in a given pattern and providing a traverse for the yarn having a predetermined reciprocating stroke range in respect to the coil, the monitoring apparatus comprising means disposed within the area encompassed by the yarn traverse range for monitoring the predetermined stroke range of the yarn and for producing an output in response to a repeated falling short of said predetermined stroke range, and means for effecting a stoppage of the yarn winding operation of the machine in response to said output of said monitoring means.

3. Apparatus according to claim 2, wherein said monitoring means comprises a yarn sensing means for producing a signal in response to the passage of the yarn adjacent thereto with a predetermined stroke range of the yarn being wound.

4. Apparatus according to claim 3, wherein said signal producing means includes means for generating a voltage pulse for each passage of the yarn thereat, and a pulse integrating circuit for said voltage pulses, and wherein said winding operation stoppage means includes means for responding to the output of said integrating circuit corresponding to a yarn traverse stroke which is repeatedly less than a predetermined value thereof, whereby a stoppage of the winding operation occurs due to a decrease in the yarn traverse stroke.

5. Apparatus according to claim 4, further including energy storage means for said integrating circuit and a timing circuit for controlling said energy storage means, and means for adjusting the time constant of said timing circuit, whereby only a repeated falling-short of the yarn traverse stoke effects the stoppage of the winding operation.

6. Apparatus according to claim 2, further including means for supplying pulses from said monitoring means dynamically to said operation stopping means.

7. Apparatus for monitoring the operation of a yarn winding machine having a yarn receiving coil and a yarn guiding drum for the receiving coil located adjacent thereto, the guiding drum having means for guiding the yarn onto the receiving coil in a given pattern and providing a traverse for the yarn having a predetermined reciprocating stroke range in respect to the coil, the monitoring apparatus comprising monitoring means disposed within the area encompassed by the yarn traverse range for monitoring the range of the stroke of the yarn, said monitoring means including a yarn sensing means for producing an output signal in response to the passage of the yarn adjacent thereto with a predetermined stroke range of the yarn being wound, means for effecting a stoppage of the yarn winding operation of the machine in response to the output of said sensing means, said sensing means including means for generating a voltage pulse for each passage of the yarn thereat, and a pulse integrating circuit for said voltage pulses, said winding operation stoppage means including means for responding to the output of said integrating circuit corresponding to a yarn traverse stroke which is repeatedly less than a predetermined value thereof, whereby a stoppage of the winding operation occurs due to a decrease in the yarn traverse stroke, energy storage means for said integrating circuit, a timing circuit for controlling said energy storage means, means for adjusting the time constant of said timing circuit, whereby only a repeated falling-short of the yarn traverse stroke effects the stoppage of the winding operation, and means responsive to the winding yarn velocity for controlling the time constant of said integrating circuit.

8. Apparatus according to claim 7, further including means for generating a constant pulse sequence and means for providing a signal corresponding to the relationship between the potential pulse sequence derived from the yarn passage sensing elements and said constant pulse sequence, and means for automatically adjusting the time constant of said integrating circuit in response to said relationship corresponding signal.

9. Apparatus according to claim 8, wherein said constant pulse generating means comprises a monostable multivibrator, and means for actuating said multivibrator in response to pulses due to yarn traverse motion, whereby the time constant of said integrating stage is adjusted as a function of the yarn winding velocity.

10. Apparatus for monitoring the operation of a yarn winding machine having a yarn receiving coil and a yarn guiding drum for the receiving coil located adjacent thereto, the guiding drum having means for guiding the yarn onto the receiving coil in a given pattern and providing a traverse for the yarn having a predetermined reciprocating stroke range in respect to the coil, the monitoring apparatus comprising monitoring means disposed within the area encompassed by the yarn traverse range for monitoring the range of the stroke of the yarn, said monitoring means including means including a yarn sensing means for producing an output signal in response to the passage of the yarn adjacent thereto with a predetermined stroke range of the yarn being wound, means for effecting a stoppage of the yarn winding operation of the machine in response to the output of said sensing means, said sensing means including means for generating a voltage pulse for each passage of the yarn thereat, and a pulse integrating circuit for said voltage pulses, said winding operation stoppage means including means for responding to the output of said integrating circuit corresponding to a yarn traverse stroke which is repeatedly less than a predetermined value thereof, whereby a stoppage of the winding operation occurs due to a decrease in the yarn traverse stroke, energy storage means for said integrating circuit, a timing circuit for controlling said energy

storage means, means for adjusting the time constant of said timing circuit, whereby only a repeated falling-short of the yarn traverse stroke effects the stoppage of the winding operation, a constant current source for respectively charging, and a constant current load for discharging said energy storage means, and means for controlling said constant current source in response to means for producing voltage pulses which are inversely proportional to the yarn velocity, whereby the effect of the yarn winding velocity is matched to the integration of the pulses derived from the yarn sensing elements.

11. Apparatus according to claim **10,** wherein said inversely proportional pulse producing means comprises a monostable multivibrator.

12. Apparatus for monitoring the operation of a yarn winding machine having a yarn receiving coil and a yarn guiding drum for the receiving coil located adjacent thereto, the guiding drum having means for guiding the yarn onto the receiving coil in a given pattern and providing a traverse for the yarn having a predetermined reciprocating stroke range in respect to the coil, the monitoring apparatus comprising means disposed within the area encompassed by the yarn traverse range for monitoring the range of the stroke of the yarn and for producing an output in response to the passing of the yarn adjacent thereto, means for effecting a stoppage of the yarn winding operation of the machine in response to the output of said monitoring means, a logic "AND" circuit element electrically disposed between the output of said monitoring means and said operation stoppage means, and means for providing a signal in response to the moving yarn connected to said logic circuit, whereby operation stoppage takes place only when the yarn is moving in the direction of the yarn guiding drum.

* * * * *