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Bartling

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[54] **METHOD AND APPARATUS FOR JOINING BROKEN ENDS**

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[52] **U.S. Cl.** ..... **57/34 R,** 57/58.95, 57/156

[51] **Int. Cl.** **D01h 15/00**

[58] **Field of Search** ..... 57/34 R, 58.89–58.95, 57/78, 80, 81, 156

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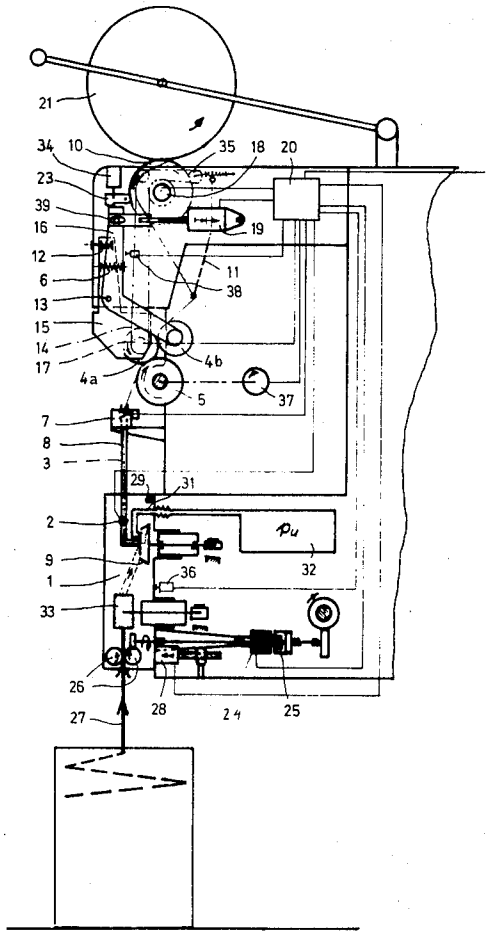
[57] **ABSTRACT**

Method and apparatus for rejoining broken thread in a spindleless spinning machine wherein the thread is formed in a turbine and withdrawn. A sensor is provided to sense the breakage of the thread and in response thereto to stop the withdrawl of the thread and of the spinning operation and to institute the cutting of the broken thread and the reversal of the thread into the spinning turbine. The return of the thread and the recommencing of the spinning being timed by an impulse counter initiated by the reversing thread passing the sensor.

12 Claims, 3 Drawing Figures



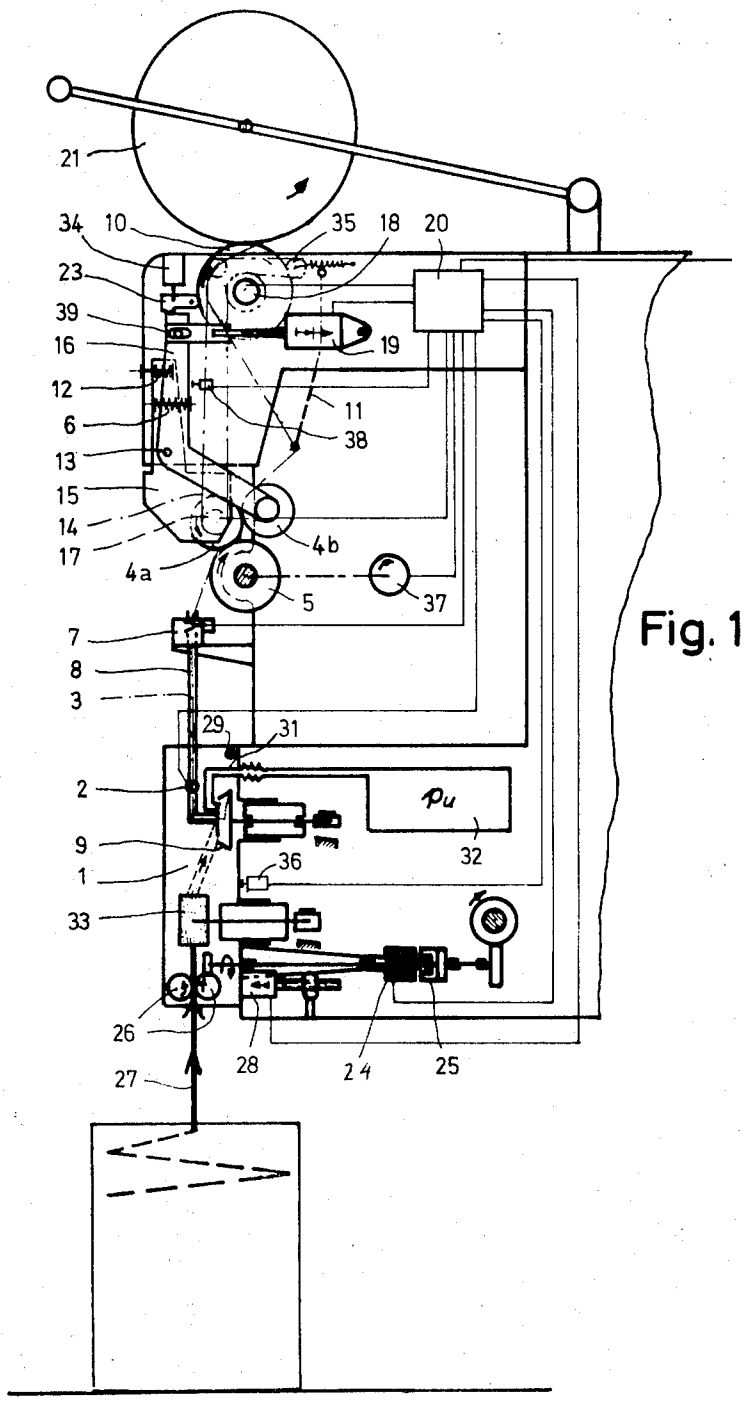

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Fig. 1

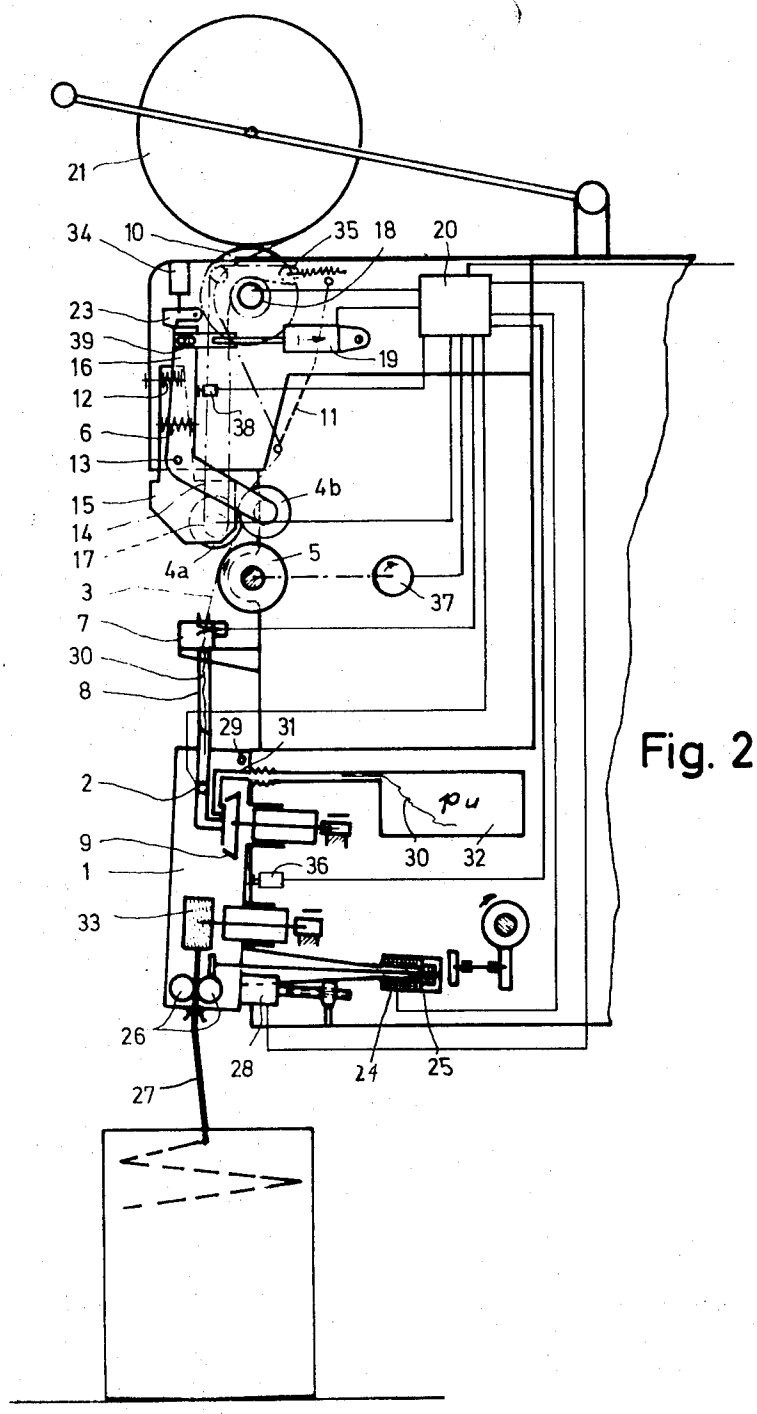
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Fig. 2

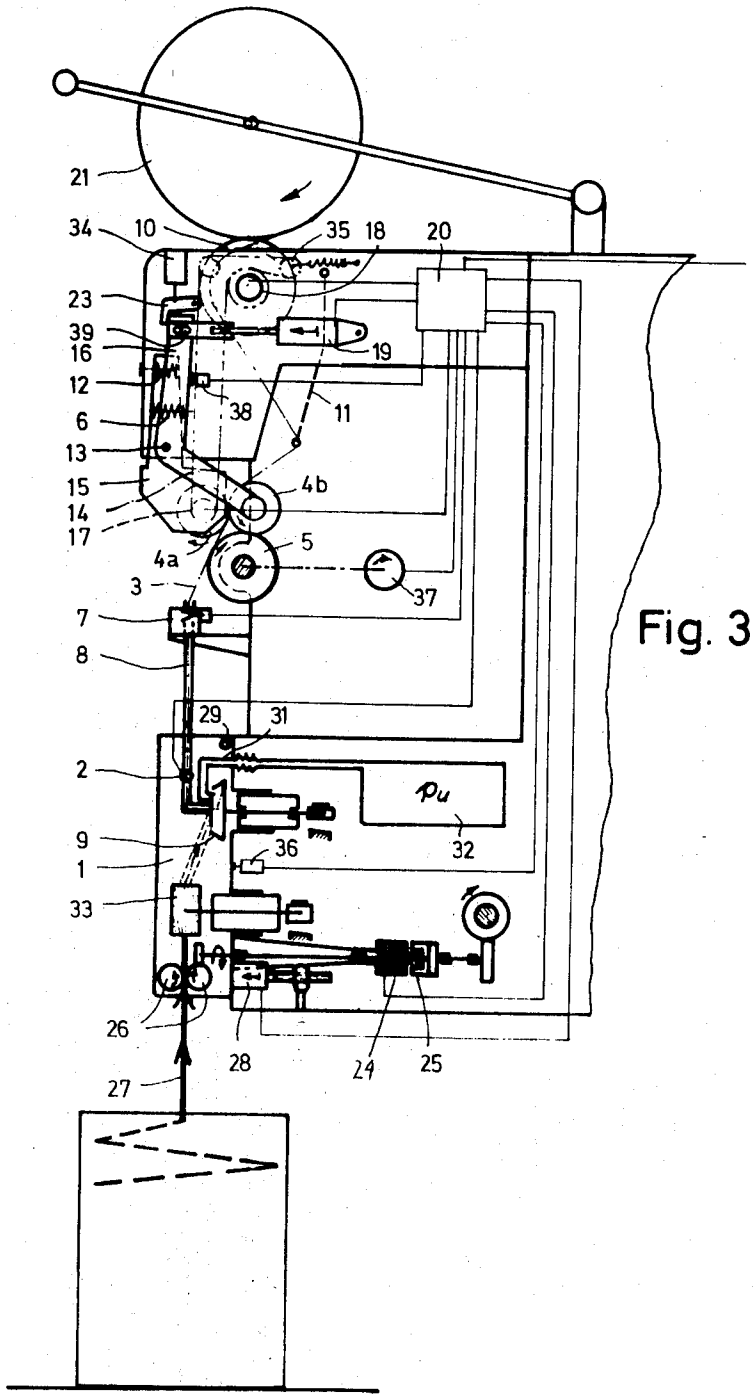
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Fig. 3

METHOD AND APPARATUS FOR JOINING BROKEN ENDS

BACKGROUND OF INVENTION

The present invention relates to a method and apparatus for the respinning of broken thread with the spinning fiber ring in spindleless spinning machines.

The respinning or joining of broken yarn with newly spun fibers in spindleless apparatus is generally carried out by stopping the spinning, cutting the broken thread and returning the thread to the spinning turbine where the newly spun fibers join with it. This operation is accompanied by great problems, since in order to make a successful juncture, a great number of factors have to be taken into consideration. This is, especially so, if the quality of the spun yarn is not to be lessened by any noticeably irregular joining points. First of all, it is necessary to eliminate the causes for the thread breakage and therefore generally a cleaning of the spinning chamber is required. Furthermore, it is necessary that the piece end or broken section of thread be removed since this piece of yarn usually has the irregularities which had caused the breaking of the yarn in the first place. Only after cleaning the turbine and establishing the clean end suitable for respinning are the preconditions for successful respinning met. Thereafter, it is necessary that the end of the clean thread which is brought back into the spinning chamber meets the fiber ring at a suitable speed so that immediately after beginning the splicing process, the withdrawl of the thread out of the spinning chamber with the desired delivery can be commenced.

Until now none of the prior art has fully satisfied all the points necessary to carry out the respinning operation securely and at a high quality.

It has been found, for instance, in the methods in which timing switches are employed that the duration of reversal of the thread, and on the other hand, of the feeding of the fiber to the spinning chamber is improperly controlled, on account of unavoidable fluctuations of the performance of the driving means and the sluggishness of the driven machine elements during starting and breaking procedures. In many cases no perfect joining can be obtained, since either the piece of thread which was returned is too short, so that no respinning at all can take place, or that the returned piece of thread is too long and can not be withdrawn at the right moment from the turbine. A process of this type and apparatus for carrying out such a process is described in the German Publication DOS 1,560,340.

In order to avoid the above difficulties, it has been attempted to make apparatus in which a predetermined length of yarn is returned to the chamber. This would have the advantage that the thread, on which the respinning takes place, should arrive exactly at the joining point. This method is, for instance, known from German Patent Publication DOS 2,012,108 which describes a machine spinning wherein after cutting of the thread end and before return of thread, a thread reserve is formed of defined length. Through this method, a lot of possible mistakes are eliminated, but on the other hand, the fluctuating time factors related to the starting of the feeding of fibers to the spinning chamber and the speed of the yarn delivery can not be dealt with in an exact and efficient manner, which would in each case assure perfect spinning together.

From Austrian Pat. No. 252,769 and its corresponding U.S. Pat. No. 3,354,631 a device for elimination of breaking threads in a spinning machine with rotating spinning chamber is known. Here the yarn outlet duct is provided with a yarn sensor and a winding spool and a pair of take-up rollers, coupled to each other by a transmission gear. The driving motor and the transmission gear are provided with a reversing gear which, when the thread is broken, are activated by the sensor, so that the spool and the take-up roller return the thread into the spinning chamber. In addition, a measuring device and a contact which is controlled by the same is provided, whereby the take-up rollers and the spool after a number of revolutions are again switched to run forward.

In this known apparatus the length of the thread which is to be returned is therefore determined by a counter and is supposed to return a defined thread length. This known device, however, shows basically the same disadvantages as were discussed above in connection with the return delivery of a defined thread length out of a thread reserve, and additionally, since there is no cutting device at a defined distance from the joining point, the length of the returned yarn is subject to uncontrollable changes, due to the irregularities of the breaking operation.

Starting at this state of the art, the present invention has the object to provide a method and apparatus for respinning a broken thread in an open end spinning apparatus, whereby, on the one hand, the return delivery of a defined thread length is assured, and whereby, on the other hand, it is also assured that the end reaches the joining or splicing point on the spinning chamber wall at the right speed and at a moment when a fiber ring of the desired consistency has been attained.

SUMMARY OF INVENTION

According to the present invention, the thread end, after a thread break, is cut at a predetermined distance from the splicing or joining point of the spinning turbine. Only after this cutting, the return delivery of the thread is commenced. The return is timed by the counting of impulses which are derived from an impulse generator which starts counting only, when the cut thread end passes a thread sensor, which lies between the cutting means and the joining point.

It has been found to be advantageous that the return delivery take place at the same speed as the withdrawl. It is especially advantageous when the distance between the sensor and the joining point is chosen in such a way, that the feeding of the fibers to the spinning chamber is commenced at the moment at which the thread end passes the sensor, so that the thread end arrives at the joining point exactly at the time that a fiber ring of the correct thread density has been formed.

The apparatus is characterized in that the thread take-up rollers comprise two jointly pivotable rollers of the same diameter, one of which is made to engage a rotating drive roller to withdraw the thread while the other roller is made to engage the drive roller for return delivery of the thread, and which both together are pivotable away from the driven roller. Further, an impulse generator is coupled to drive roller so that perfect timing can be obtained. It has been of advantage to pivot the take-up rollers around a common center of gravity by means of a common element connected with the control circuit.

Further advantages and particulars of the invention are described hereafter and are shown clearly in the drawing.

BRIEF DESCRIPTION OF DRAWING

In the drawings:

FIG. **1** is a plan view of apparatus for carrying out the inventive method shown during normal spinning procedure;

FIG. **2** is the apparatus according to FIG. **1** in the manufacturing position after a thread break and when the respinning is being prepared; and

FIG. **3** is the apparatus according to FIGS. **1** and **2** in the manufacturing postion during the return delivery of the yarn to the spinning chamber.

The method of the present invention is best described together with the inventive apparatus by which the steps may be carried out. As seen in FIG. **1**, a spindleless spinning assembly, generally depicted by the numeral **1**, comprises a rotating spinning turbine **9** mounted within the chamber of an enclosed housing. The construction of the spindle assembly may be conventional in form and its details are therefore known to those skilled in this art. The assembly produces in the known manner a thread **3** which is pulled through an outlet channel or tube **8.** In accordance with the present invention an electrical sensor, such as a photoelectric cell **2** cooperating with a light source or similar device is mounted on the tube **8** to sense the continuity of the thread **3.** The thread **3,** in normal operation (FIG. **1**), is withdrawn from the spinning tubine **9** by a pair of take-up rollers or nip rollers **4***a* and **4***b* which are biased to press against each other. The rollers **4***a* and **4***b* have a smooth outer circumference and are driven by a continuously clockwise rotating wheel or roller **5** which extends across and in contact with each of similar rollers employed along the spindle bank of a multiple spinning assembly machine. The roller **4***a* is mounted at the end of a lever **15** which is biased by a spring **12** to pivot about a point **13** into normal operating engagement with the drive roller **5.** The roller **4***b* is mounted at the end of a bell crank **16** also pivoted at the point **13** and biased by a spring **6** to press the roller **4***b* against the surface of roller **4***a* for conjoint swinging and rolling.

The thread **3** passes over a dancer roll and arm **11** which is adapted to oscillate and resiliently accumulate a length of thread in reserve during the operation of the apparatus. The thread **3** then passes over a grooved drum **10** on which a take-up spool **21** rests. The grooved drum **10** rotates the spool **21** and acts to apply the thread in an even manner across it. The drum **10** and therefore the spool **21** abutting against it is driven by the roller **4***a* abutting against the common drive roller **5** via a transmission such as a chain or belt **14** arranged with the axle or shaft for roller **4***a*.

The electric sensor **2** is connected to a control circuit schematically shown by the numeral **20.** The control circuit may employ one or more relays, solid state amplifier circuits, timing devices, etc. The photoelectric sensor suggested is of conventional construction producing an electric signal output on sensing the presence or absence of a given object in line with it. In the present situation should the normal operation of the spinning assembly be disturbed by a break in the thread **3** (see FIG. **2**), the sensor **2** produces a signal passing to the control circuit **20.** Operatively connected to the control circuit are a pair of brake means **17** and **18** which are mounted respectively to stop the rotation of either or both of the rollers **4***a*, **4***b* and the groove drum **10** on command of the control circuit on receipt of a signal inducing a break in the thread. A two stage actuator **19** such as a double winding solenoid with magnet core is mounted generally perpendicular to the long arm of the bell crank **16** and is connected to it by a bolt and pin **39.** The actuator is adapted to move the lever **16** and to hold it securely against the roller **4***a* so that both of said rollers **4***a*, **4***b* come free of the driving roller **5.** Simultaneously rollers **4***a* and **4***b* are stopped by the braking means **17.** This stops the movement of the thread **3** and maintains the length of the thread hanging in the outlet tube **8** below the rollers **4***a* and **4***b*. The movement of the lever **16** by the actuator **19** is limited by a micro-switch or the like arranged at a predetermined distance from the edge of the lever **16.** In stopping the rollers and the grooved drum **10** the dancer roller and arm **11** acts to provide a sufficient length of thread in case spool **21** due to its weight has not yet stopped completely.

Simultaneously with the stopping of the thread movement, the control circuit causes a normally closed resiliently biased clutch or coupling **25** to open by deenergizing its solenoid coil **24.** The clutch **25** normally operates the paired feed rollers **26** by which the raw fiber band **27** is fed to the spinning chamber. After a predetermined time delay, the control circuit **20** activates a cutting element **7** which is arranged between the spinning assembly **1** and the rollers **4***a* and **4***b*. The cutting element **7** is mounted at the end of the tube **8** in axial alignment with the thread and may be of conventional construction known to those skilled in the art. The spinning turbine **9** is maintained under vacuum via a conduit **31** extending from a source of vacuum **32** such as a reservoir or air pump. The piece of thread remaining in the outlet tube **8** cut by the cutter **7** is thus carried away together with the other fiber particles, pulp, etc., present in the spinning chamber. This removes from the thread **3** the portion of the thread in which the irregularity causing the yarn breakage in the first place and leaves a cohesive well formed thread end.

The spinning assembly housing is pivoted at its upper end **29** and is swung from its other end by a second solenoid or similar actuator **28** having a rod reciprocable in the path indicated by the arrow. The drive whorls for the spinning turbine **9** and the fiber picker and loosening rollers, generally depicted by the numerals **26** and **33,** extend out of the housing. Solenoid **28** is actuated by a signal from the control circuit **20** so that the housing is pivoted simultaneously with the application of brakes **17** and **18** and the actuation of the first solenoid **19** so that the spinning turbine **9** and the fiber pickers **33** are also disengaged from their drive means as seen in FIG. **2.**

As soon as the housing pivots into the position seen in FIG. **2** under action of actuator **28,** it releases a second micro-switch **36** which causes the control circuit **20** to further activate the actuator **19** to pull the upper arm of bell crank **16** further to the right. This latter movement causes the roller **4***b*, which is of the diameter as its companion roller **4***a*, to engage the surface of the drive roller **5.** On reaching this position (FIG. **3**), a latch **23** falls behind the upper arm of the lever **16** overcoming the effect of spring **12** and holding the lever **16**

in the position where roller 4*b* is rotated by the continuously rotating drive roller **5**. The brakes **17** and **18** are simultaneously released. The rotation of the roller 4*b* is thus reversed from it normal operation direction; i.e., when roller 4*a* is in contact with the roller **5**, and in this event, will cause the thread **3** to be pulled downwardly. The slot **39** is of a length that after latch **23** engages the lever, the actuator **28** may be returned to its forward or original position.

Through the aforedescribed switching process, the thread **3** with its end is moved backwardly through the tube **8** into the spinning chamber without reversal of any of the drive means or special operation of the other parts. At the instant the backwardly moving cut thread **3** passes the photo sensor **2**, a new impulse signal is sent to the control circuit. The control circuit **20** in turn causes the coupling **25** to close, and the solenoid actuator **28** to release the housing all of which places the fiber feed rollers **26**, the picker **33** and the spinning turbine back into action, even while the thread reverses. Simultaneously, an adjustable impulse generator **37** which is driven by the common drive **5** closes and begins producing a series of impulses.

The fiber fed from the feed rollers **26** is spun, in conventional manner by centrifugal action against the inner wall of the spinning turbine **9**, and is drawn off from the so called binding or splicing point which is fixed within the general limits on the face of the spinning wall. The constant path and distance over which cut thread **3** must be returned between the thread sensor **2** and the binding point of the spinning turbine can be compared with a multiple of impulses generated by the impulse generator **37**, which multiple can be predetermined. Thus, after a predetermined number of pulses indicative of the time necessary for the thread to come back to the binding point and automatically splice itself, the control circuit is caused to energize a magnet **34** which lifts the latch **23** releasing the lever **16**, which for all the preceding time was holding roller 4*b* against the drive roller **5**. On release of lever **16** roller 4*b* is freed allowing the roller 4*a* to return into contact with the drive **5**, thus placing the entire apparatus back into its normal production position as shown originally in FIG. **1**. During switching back to normal operation, the take-up roller **21** slips over the grooved drum **10**, permitting the dancer arm **11** to rebuild adequate reserve yarn. The dancer arm **11** also acts to simultaneously prevent the edge of the spool **21** from hardening which through the lateral deflection of the thread relative to the winding of the spool. By taking up the thread, the dancer arm relieves the pressure which would accur at the edges of the spool due to the greater distance of the edges from the rollers 4*a*, 4*b* by yieldably moving to the left in the drawings.

It is to be noted that the brakes **17** and **18**, as well as the magnetically operated latch **23**, are auxilliary means to insure the operation of the device, particularly, the levers within a time range of milli-seconds. These elements known may be omitted, if the actuator solenoid device **19** can be found which itself operates in an extremely short period of time. It is also to be noted that the belt or chain **14** connecting the drive of the rollers with the grooved drum **10** is held under proper tension by tensioning roller **35** resiliently spring biased, to compensate for the changes in distance during the swing of roller **14**.

From the foregoing description it will be clear that the inventive method and apparatus provides extremely short periods of switching times. Thus, the time in which the pull rollers are actually stopped is extremely short and virtually instantaneous. The parts have relatively small size and mass and the clamping point of the thread between the two rollers 4*a* and 4*b*, as defined by the associated levers, having a common pivotal point, is easily determined. Consequently, irregularities in starting and stopping of the drive means for withdrawing and reversing the thread have little effect on the proper alignment. Further, the fact that the cut thread end arrives at the sensor, only after the drive means have reached peak power and have stabilized, insures that the impulses generated are an accurate time indication of the distance the thread travels. As a result, the present device insures that the tip of the thread reverses in time so that it meets exactly the binding point of the fiber ring or fiber tow formed in the spinning chamber.

It will be seen from the foregoing that the thread end is cut at a predetermined distance from the spinning chamber and its reversal is timed with the reactivation of the spinning operation, (i.e., feed and turbine spin) so that the thread reaches the chamber just as the spun fiber makes a cohesive, fully dense rope or tow at the chamber binding point. Thus, the joining of the thread and fiber makes a smooth continuous and nearly perfect thread juncture. This timing is, of course, accomplished by the fact that the counting of the impulses begins only when the cut thread passes the sensor, and not at the time it reverses.

The present disclosure is illustrative and should not be taken as limiting of the present invention.

The application is a companion to and relates to apparatus shown and described in each of the following U.S. applications, all filed on even date hereof and reference is made to the specifications, claims and drawings of each and their disclosures incorporated herein, as if more fully set out herein:

- Ser. No. 264,528 corres. to German Appln. P 21 30 739.1, Wilhelm Braun, Mounting Apparatus for Spinning Assembly
- Ser. No. 264,529 corres. to German Appln. P 21 30 722.2, Rudolf Schön, Apparatus for the Spindleless Spinning, now U.S. Pat. No. 3,789,597
- Ser. No. 264,530 corres. to German Appln. P 21 30 738.0, Gerhard Bartling Device for Open End Spinning, now U.S. Pat. No. 3,789,990
- Ser. No. 264,531 corres. to German Appln. P 21 30 724.4, Rudof Schön, Apparatus for Withdrawing Thread, now U.S. Pat. No. 3,778,989
- Ser. No. 264,450 corres. to German Appln. P 21 30 725.5, Gerhard Bartling, Multi-unit Spinning Machines, now U.S. Pat. No. 3,774,382

The German applications were all filed on June 21, 1971. The assignee is common to all.

Finally, it should be indicated that the abovementioned electric circuitry as far as it is not described in detail may be designed in any usual and convenient manner as known to those skilled in the art of electric, electromechanic and electronic devices.

More specifically the impulse counter could be comprised of one or more of the well known counting relais. Of course, it would also be possible to take an electronic counting device provided, however, that suitable amplifiers are connected between the counting

device of the pulses and its associated devices, e.g., solenoid switches in the control device.

What is claimed:

1. A method for rejoining a broken thread with the spinning fibers in a spindleless spinning machine having a chamber to which the fibers are fed, a turbine for spinning said fibers and means for withdrawing said fibers, comprising the steps of sensing the movement of said withdrawn thread, producing a first signal responsive to a break in said thread, and in response to said signal initiating an automatic program for sequentially stopping the withdrawal of said thread, cutting a portion from the end of said thread, reversing the movement of said thread to said chamber, producing a second signal responsive to the reverse movement of said cut end, producing a series of impulses in response to said second signal, and after a predetermined number of said impulses recommencing the withdrawal of said thread.

2. The method according to claim **1** including the step of withdrawing and returning to said chamber said thread at the same speed.

3. The method according to claim **2** including the step of arresting the spinning and feeding of fibers in response to the first signal and recommencing the spinning and feeding thereof in response to said second signal.

4. The method according to claim **2** including the step of timing said impulses so that the distance said thread reverses from the production of said second signal to said spinning chamber equals the time required to spin said fibers in said chamber into a cohesive thread.

5. A spindless spinning machine comprising a chamber, means for feeding fibers to said chamber, a rotating turbine located in said chamber, for spinning said fibers into thread and means for withdrawing said thread, means for sensing said withdrawn thread, means for producing a first signal responsive to the sensing of a break therein, means responsive to said first signal to sequentially stop said withdrawing means, means for cutting a portion from the end of said thread and means for causing said withdrawing means to reverse and return said cut thread to said chamber for joining with said spinning fibers, said cut thread being moved past said sensing means, means for producing a second signal in response to the reverse movement of said cut thread past said sensing means, said sensing means producing a predetermined number of impulses in response to said second signal, and said withdrawing means being responsive to the last of said predetermined number of impulses to again reverse said withdrawing means to recommence withdrawl of said joined thread from said chamber.

6. The apparatus according to claim **5** wherein the means for withdrawing a returning said thread comprises a pair of rollers each mounted on a lever resiliently biased against each other to hold the thread therebetween, said rollers having the same diameter, a drive roller continuously rotating in one direction, and means normally maintaining one roller in sole contact with said drive roller for selectively withdrawing said thread and shifting the other roller into sole contact with said drive roller for reversing said thread.

7. The apparatus according to claim **6** including an impulse generator mechanically connected to said drive means for producing a steady stream of reference impulses.

8. The apparatus according to claim **6** including a control circuit responsive to said first signal, a control actuator for moving said levers, said circuit providing a signal for said actuator.

9. The apparatus according to claim **6** including a thread take-up spool and a thread guide drum interposed between said rollers and said thread take-up spool, said spool resting on said guide drum and being driven thereby, and transmission means connecting said guide drum with said rollers for conjoint rotation.

10. The apparatus according to claim **9** including a dancer arm for taking-up thread responsive to the pull on said thread, located between said rollers and said guide drum.

11. The apparatus according to claim **5** wherein said cutting means is located a predetermined distance from said spinning chamber and said impulse generator is caused to produce a number of impulses conforming to said distance in time.

12. The apparatus according to claim **11** wherein said means for sensing said thread is located at a predetermined distance from said cutting means and said counting of said impulses is initiated at the moment said cut thread passes said sensing means.

* * * * *