Nov. 13, 1956 T. FRANKEL 2,770,091

CONTROL UNIT FOR CABLE SPINNING MACHINE

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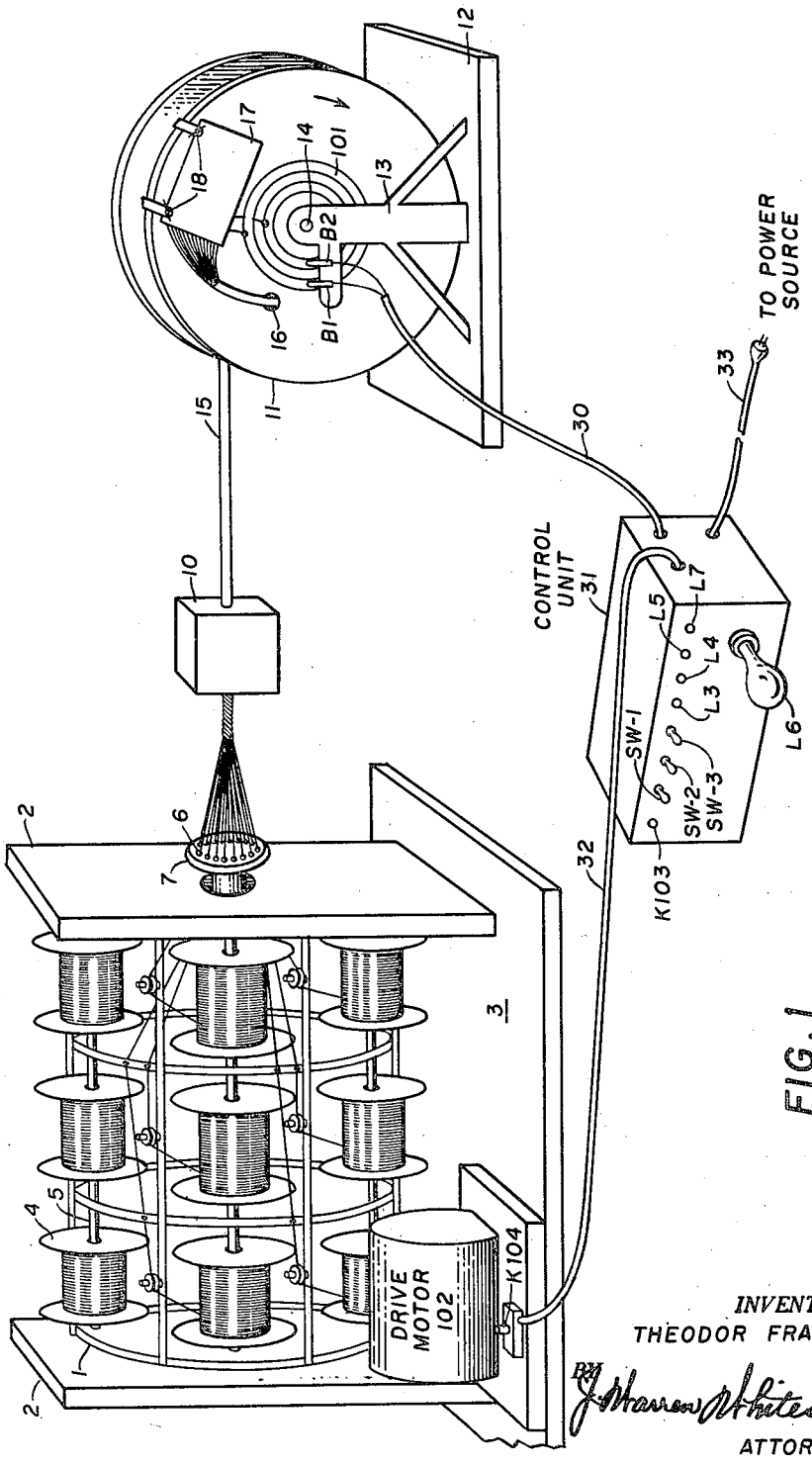


FIG. 1

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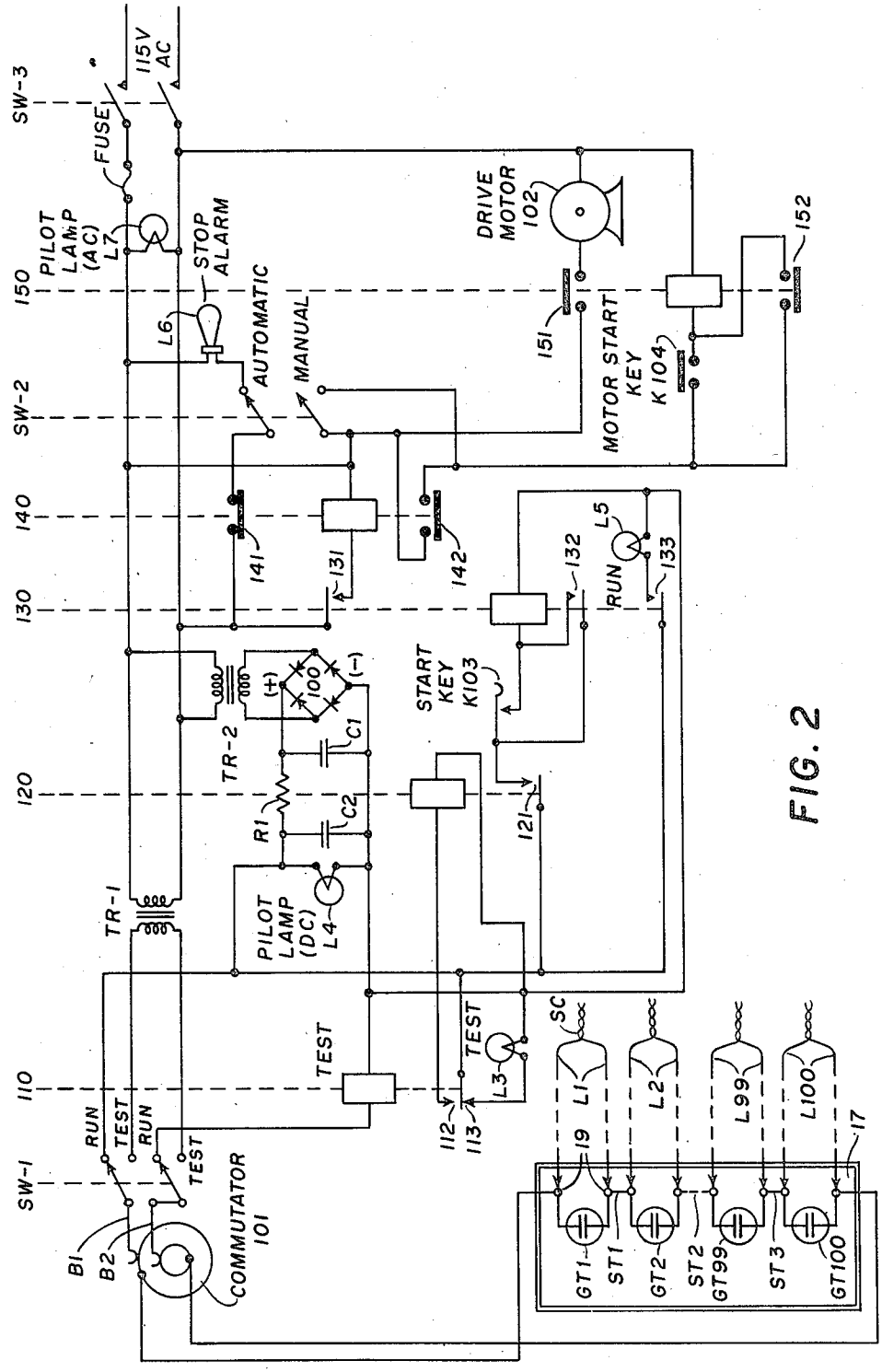


FIG. 2

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CONTROL UNIT FOR CABLE SPINNING MACHINE

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11 Claims. (Cl. 57—81)

This invention relates to control units for cable spinning machines and more particularly to means for detecting broken wires during the spinning or forming process.

This invention involves a control device for machines used to form or manufacture large cables containing many conductors. Very often, one or more of the wires comprising this cable break during the spinning operation. In the past, detection of these breaks has been possible only when each wire is checked for continuity after the cable is completed. That is to say, each wire comprises an electrical conductor surrounded by a suitable insulating material. There have been devices to detect a complete mechanical break including both the electrical conductor and the insulating material. However, there has been nothing to detect a broken wire during spinning where the insulating material remains intact and has sufficient strength to provide mechanical continuity along the length of the wire. Various methods have been used to locate the break in the electrical conductor only after termination of the spinning process; however, none of the known methods is very accurate so that an exact "pin pointing" of the fault is not possible with prior methods and apparatus. Furthermore, once the approximate location of the discontinuity has been found, the insulation must be removed before the break can be repaired. If the fault has not been located with great accuracy, considerable insulation damage may result, which may cause faults later in the life of the cable.

One object of this invention is to provide a new and improved control unit for cable spinning machines.

Another object is to provide means in cable spinning apparatus for detecting broken conductors while cables are being spun.

Yet another object of this invention is to provide means in cable spinning apparatus for detecting during spinning any electrical discontinuity in a wire forming the cable despite the fact that the insulation of the broken wire remains intact and is strong enough to provide mechanical continuity along the length of the wire.

Still another object of this invention is to provide means in cable spinning apparatus for stopping the spinning process automatically upon the occurrence of a break.

A further object of this invention is to provide means in cable spinning apparatus for delaying the restarting of the spinning process following a break until the break has been repaired.

Briefly this invention provides a cable spinning machine having a terminal block to which the conductors comprising the cable are connected. All of these conductors are then connected in a series circuit. This circuit is taken-off the spinning machine by means of a commutator to which a test relay is connected. If any conductor breaks during the spinning process the series circuit is opened to control the test relay, and responsive thereto spinning is automatically stopped until the break is repaired and the series circuit is again completed so that the test relay may be recontrolled.

The particular manner of controlling the test relay is not material to my invention. For example, the relay could be shunted by the series circuit so that it would operate upon the occurrence of a break, or it could be arranged to be operated by the series circuit and released upon the occurrence of a break. Also, other well known arrangements could be provided.

These and other objects will become more apparent by reference to the accompanying specification and drawing.

Fig. 1 shows a spinning machine of the type which is suitable for use in connection with my invention.

Fig. 2 is a schematic circuit diagram of a control unit for a spinning machine.

Referring to Fig. 1 in greater detail, there is shown a generalized spinning machine of the type adapted for use in connection with the subject invention. This machine comprises a base section 3 upon which are mounted upstanding support elements 2 which may be arranged to support a rotatable cylinder-like arrangement 1. This arrangement is provided with a plurality of openings or recesses into which spools, such as 4, may be fitted and held by any suitable support, such as spindle arrangement 5, which is capable of allowing the spool to unwind freely.

Previously, a pair of conductors were wound on each of the spools, such as 4. The two internal ends of each pair of conductors are connected together at any convenient time, such as before being wound on the spool, for instance, by any suitable means, such as by twisting, for example, to provide a short-circuit between the two conductors comprising the pair. By internal ends, I mean those ends which are the last to leave the spool as it is unwound in the spinning process as distinguished from the outer ends which are connected through the spinning machine at the start of the cable making process. The outer ends of the wires are threaded from the spools such as 4, for example, through a plurality of openings such as 6 in end 7 of cylinder-like arrangement 1.

The cylinder-like arrangement 1 is adapted to rotate under the influence of drive motor 102 thereby forming a cable by twisting all conductors into a compact bundle of wires as they leave opening 6 in end 7 of the cylinder-like arrangement. Then, this twisted cable is fed through box 10 where a suitable outer covering may be provided; for example, the outer covering could be fabric, plastic, lead or the like. The cable is carried from box 10 to take-up reel 11 which is preferably of a type that is suitable for removal and shipment to a consumer once the finished cable has been wound thereon.

Take-up reel 11 is supported on base 12 by any suitable means such as upstanding supports 13 and axle 14 which extends through the reel so that it may be rotated to wind cable 15. The starting end of cable 15 may be extended through an opening 16 which is provided near the center of the reel. A terminal block 17 is attached to take-up reel 11 by any suitable means such as by screws or by "C-clamps" 18, for example. This block is provided with a plurality of terminals 19 to which conductors of cable 15 may be attached as shown in Fig. 2. Gas tubes GT1 . . . GT100 are connected across each pair of cable ends as shown in Fig. 2.

Commutator 101 is arranged to rotate with the reel. For example, it may be bolted to the side of reel 11 or it may be an integral part of axle 14. Brushes B1 and B2 are positioned to cooperate with the conductive segments of commutator 101. Brushes B1 and B2 are connected by cable 30 to control unit 31. Drive motor 102 is connected to control unit 31 by a cable 32. Power cable 33 may be connected to any suitable power source.

To set-up the spinning machine, the wires wound on spools, such as 4, may be threaded through openings, such as 6, at which point they are to be twisted into

cable 15. The wires are then brought through element 10 where an outer covering is applied and the cable is further extended through opening 16 where conductors of the cable are fanned out and connected to the terminal block. Following this switches SW–1, SW–2, SW–3, and keys K103 and K104 are operated to a proper position so that drive motor 102 causes cylinder-like arrangement 1 to rotate thereby twisting the various pairs of conductors to form cable 15.

Rotation continues and cable 15 is spun until a break occurs in any of the conductors at which time stop alarm lamp L6 lights. Also responsive to the break, drive motor 102 stops to cause cylinder-like arrangement 1 to cease rotating. The spinning machine operator makes a test to determine which pair includes the broken conductor. To do this he merely operates switch SW–1 and one of the gas tubes such as GT1, lights as an indication that its associated pair includes the broken wire. The control apparatus necessary to perform all of this function responsive to a broken conductor is in control unit 31 and will be explained later in greater detail.

Next, the spinning machine operator goes to the indicated pair, finds and repairs the broken conductor. Following this he reoperates the necessary switches and keys to cause drive motor 102 once again to rotate cylinder-like arrangement 1 thereby spinning cable 15. The control unit may be arranged so that it is not possible to reoperate drive motor 102 until the broken pair is repaired.

Referring to Fig. 2, cable 15 is shown as comprising four pairs of conductors L1, L2, L99 and L100 the outer ends of which are connected to suitable terminals 19, certain of which in turn are strapped together as shown by means of straps ST1, ST2 and ST3 in order to connect the aforementioned pairs in a series circuit. Strap ST2 is shown in Fig. 2 as a dotted line since any number of conductor pairs may be provided. For example, there could be ninety-six pairs between conductors L2 and L99 thus making a total of a hundred pairs. It should be noted that strappings ST1, ST2 and ST3 and short circuits SC cooperate to provide a continuous series circuit including the entire length of all wires in the cable.

Means is provided for connecting the terminal block 17 and hence the series circuit to the control circuit of Fig. 2. Any suitable connecting device may be used; however since take-up reel 11 is rotating, it is desirable to connect the series circuit to insulated surface contacts from which the circuit may be further extended by current-collecting brushes. I have shown this sliding contact arrangement as including commutator 101 and and brushes B1 and B2, for example.

In order to connect the control circuit to a suitable source of potential, switch SW–3 is closed and 115 volt A. C. current is connected through a protective fuse to transformers TR–1 and TR–2. Pilot lamp L7, connected across the 115 volt line, lights to indicate that the unit is operatively connected to an A. C. source. Assuming that switch SW–2 is in the "automatic" position as shown in the drawing, stop alarm lamp L6 is connected across the A. C. line.

The current supplied through transformer TR–2 is rectified by any suitable means 100 to provide a D. C. power supply for operating the various relays. While many different types of rectifier elements could be used, I show a simple bridge arrangement comprising semiconductor elements. A filter network comprising capacitors C1 and C2 shunting the rectifier output on either side of resistance R1 is used to produce a smooth D. C. voltage. In order to indicate the presence of D. C. voltage, pilot lamp L4 is connected across the output side of the filter network. Lamps L4 and L7 are aids to the spinning machine operator so that he may know that everything is functioning properly.

Switch SW–1 is placed in its run position as indicated in the drawing. This places test relay 110 in series with the series loop formed by the conductors L1 . . . L100. This loop may be traced from the (+) side of rectifier 100 through resistance R1, the upper run terminal and blade of switch SW–1, brush B1 of commutator 101, conductors L1 (including short circuit SC) strap ST1, conductors L2, strap ST2, conductors L99, strap ST3, conductors L100, brush B2, lower blade and associated run terminal of switch SW–1 and the winding of test relay 110 to the (—) side of rectifier 100.

First, let it be assumed that all of the conductors, L1 . . . L100 are continuous and that no break has occurred. Test relay 110 operates over the series loop of conductors to close contacts 112 while opening contacts 113. Since test lamp L3 is connected in series with contact 113, lamp L3 is extinguished upon the operation of relay 110 as an indication that the loop is complete. Again this is mere an aid to the operator and is adapted to show that the circuit is functioning properly. Contacts 112 close to complete a circuit from the (+) side of rectifier 100 through contact 112 and the winding of relay 120 to the (—) side of rectifier 100.

Relay 120 operates. Contacts 121 close to prepare a circuit for operating relay 130. This circuit may be traced from the (+) side of rectifier 100 through operated make contacts 121 to start key K103.

Upon the observation of extinguished lamp L3, start key K103 may be operated to complete the operating circuit through the winding of relay 130 to the (—) side of rectifier 100. Contacts 132 close to shunt the contacts of key K103 and eliminate the need for maintaining start key K103 operated. Conctacts 133 close to light run lamp L5 as an indication that the spinning machine may be started. Contacts 131 close to energize A. C. relay 140. Responsive thereto, contacts 141 open to extinguish stop alarm almp L6 while contacts 142 close to prepare a circuit for operating A. C. relay 150. Contacts 141, 142, 151 and 152 and key K104 are heavy duty power contacts; therefore they are conventionally shown by a symbol which is different from the other relay contacts.

When the spinning machine operator observes extinguished stop alarm lamp L6, motor start key K104 may be operated. This key may be connected at any suitable location; however, usually, it is a part of the spinning machine itself as distinguished from the control unit.

In response to the operation of the start key K104, relay 150 operates over a circuit that may be traced from the 115 volt A. C. supply through contacts 142, operated motor start key K104, the winding of relay 150 and back to the 115 volt supply. Contacts 152 close to shunt the contacts of key K104 and eliminate the need for holding motor start key K104 operated. Contacts 151 close to connect drive motor 102 to the 115 volt A. C. power supply, or to any other suitable source. For example, some motors may require a 440 volt source. Motor 102 comprises part of the means for causing the conductors to be formed into a cable, i. e., it drives the spinning machine which continues to operate until a break occurs in any one of the pairs L1 . . . L100.

Upon the occurrence of a discontinuity or break in the series circuit comprising conductors L1 . . . L100, test relay 110 releases. Responsive thereto, contacts 113 close and lamp L3 lights as an indication that a test should be conducted to determine where the break has occurred. Contacts 112 open to release relay 120. Relay 120 drops to open contacts 121 thereby releasing relay 130 which had been holding over its own locking contacts 132. Contacts 133 open to extinguish run lamp L5. Contacts 131 open to release relay 140. Responsive thereto, contacts 141 close to light stop alarm lamp L6. Contacts 142 open to break the operating circuit for relay 150 which had been holding over its locking contacts 152. Contacts 151 open to stop drive motor 102.

The spinning machine operator observes stop alarm

lamp L6 and test light L3 both of which are lit. This indicates that a test should be conducted to determine which pair includes the broken wire.

To conduct this test, switch SW–1 is operated to its test position. This connects the 115 volt A. C. power supply which is extended through transformer TR–1 and contacts on operated switch SW–1, to brushes B1 and B2 and the broken loop through conductors L1 . . . L100.

A plurality of discontinuity signal means are provided in the form of gas tubes bridged across the outer ends of each pair so that each is connected across one gas tube. Each complete and unbroken pair short circuits one of the gas tubes GT1 . . . GT100; however, the pair containing the break does not short circuit its associated gas tube which is constructed to fire when subjected to 115 volts. For example, if tube GT2 were to fire, it would be an indication that the break is in pair L2; on the other hand, if GT100 were to fire, it would be an indication that the break is in pair L100.

The machine operator makes the repair and returns switch SW–1 to its run position whereupon test relay 110 operates and the process outlined above is repeated so that the spinning process continues until another fault occurs.

Switch SW–2 provides an option by means of which the spinning machine runs continuously and without regard to the occurrence of a break. In this condition (switch SW–2 operated to the manual position) the circuit for operating relay 150 is completed independently of contacts 142 upon operation of key K104 and the circuit for drive motor 102 is completed from the 115 volt A. C. power supply through contacts 151 as previously described. Hence, when a break occurs relays 110, 120, 130 and 140 may release but the motor continues to operate. As in the previous example, lamp L3 lights and lamp L5 is extinguished as an indication that a break has occurred. The spinning machine operator may then stop the spinning process manually, if desired, and repair the break if necessary. This feature is most useful in re-reeling and in running the spinning machine to a start position before the conductors are connected to the terminals at the start of the spinning process.

While I have shown a single embodiment of my invention, it should be obvious that other arrangements could be provided. For example, test relay 110 is preferably very sensitive to operate and release quickly and relay 150 should carry heavy duty contacts; therefore, I have shown a plurality of relays in Fig. 2. However, there is no reason why many of the relays could not be eliminated if properly designed sensitive relays having heavy duty contacts are used. In like manner, I have shown many lamps as an aid to the detection of faults in the control circuit. These lamps could be eliminated. Still other modifications could be made without departing from the scope of my invention. Therefore, the appended claims are drawn to cover not only specific details shown in the drawing but also to cover other modifications which may fall within the true spirit of my invention.

What I claim is:

1. A control unit for a cable spinning machine comprising; a plurality of insulated conductors, means for causing said conductors to be formed into a cable, means for continuously checking the electrical continuity of said conductors during the formation of said cable, and means for stopping said cable forming means responsive to the occurrence of an electrical discontinuity in any of said conductors.

2. The control unit of claim 1 and means for indicating which of said conductors includes said electrical discontinuity.

3. The control unit of claim 1 wherein means is provided for connecting all of said conductors in series, and said continuity checking means comprises a relay controlled by said series circuit.

4. The control unit of claim 3 with means for operating said relay via said series circuit, whereby said relay releases responsive to said discontinuity, and means responsive to release of said relay for causing said stopping means to stop said cable forming means.

5. The control unit of claim 4 wherein said plurality of conductors are arranged in pairs, and having means for shorting together one end of each of said pair of conductors and a gas tube bridging the other end of each of said pair of conductors.

6. In the control unit of claim 5, source of test voltage, means for connecting said test voltage across said series circuit whereby each of said gas tubes which is individual to a continuous pair of conductors is short circuited, but said gas tube which is individual to a pair of conductors having a discontinuity is not short circuited.

7. The control unit of claim 1 and means for preventing reoperation of said means for causing the formation of said cable until said discontinuity is repaired.

8. A spinning machine control unit comprising a plurality of pairs of conductors, a spinning machine for forming said conductors into a cable, a terminal block, means for connecting one end of each of said conductors to said terminal block, means for short circuiting the other ends of said conductors by pairs, means for strapping said terminals so that each of said conductors is joined in a series circuit, a contact device, means for connecting said series circuit to said contact device, test means connected to said contact device to be controlled over said series circuit, means for starting and stopping said spinning machine, and means responsive to the operation of said test means for controlling said starting and stopping means.

9. The spinning machine control unit of claim 8 and a plurality of discontinuity signals means, one connected in parallel with each of said pair of conductors.

10. A spinning machine comprising a cylinder-like arrangement, a plurality of spools of wound pairs of conductors, means for carrying said plurality of spools in said arrangement, means for extending said conductors from said arrangement, a drive motor for rotating said arrangement to twist said extended wires, a take-up reel on which said conductors may be wound, a terminal block connected to said take-up reel, said conductors being connected to said block, strapping on said block, said conductors being connected in series by said strappings, a commutator having sliding contacts connected to said series circuit, and means comprising said contacts for controlling said drive motor, said last named means comprising means for stopping said drive motor upon the occurrence of a break in any of said conductors.

11. The spinning machine of claim 10 and means in said control means for preventing reoperation of said drive means until said break is repaired.

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