

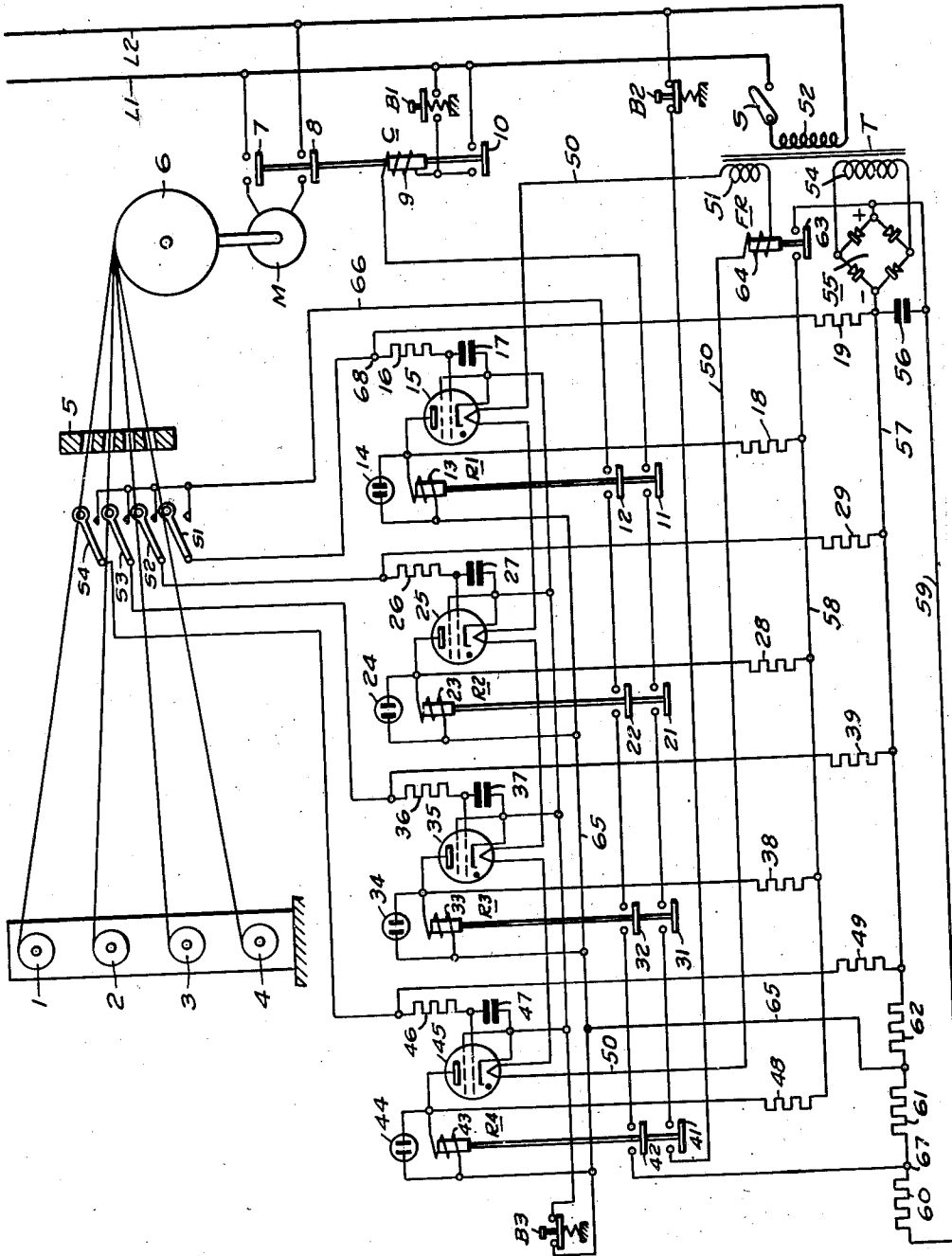
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RELAY SYSTEM

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WITNESSES:

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RELAY SYSTEM

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My invention relates to relay systems which automatically stop the operation of machinery in response to the occurrence of a fault in any one of a large number of points under supervision. Such systems are being used, for instance, in warping, weaving, knitting, and other textile machinery or other strand, thread, yarn, wire fabricating apparatus in order to stop an electric drive motor when any of the fabricated individual strands of material breaks or unduly reduces its tension.

It is known to connect the fault-responsive element in systems of the above-mentioned type with the respective grid circuits of electronic trigger tubes which, when fired, causes the motor contactor to drop out; and it has been proposed to connect each trigger tube with a signal lamp in order to indicate to the operator the location of the fault.

The invention, more specifically, relates to selectively indicating relay systems of the just-mentioned kind and has for its object to improve these systems as to reliability of selective indication and also in such a manner as to greatly reduce the skill and attention required from the operator, adjuster or supervisor without appreciably increasing the amount or cost of equipment used as compared with the known systems.

When in the known systems, the machinery is stopped due to the occurrence of a fault, such as a yarn break in a knitting or other textile machine, it happens frequently that all threads become slack with the result that many or all fault-responsive elements fire the respective trigger tubes. Then many or all indicator lamps will glow thus making it difficult or impossible to determine the one faulty thread that caused the stoppage. It is also necessary that after a fault-responsive stopping of the machinery, if the location of the fault is properly indicated by a single glowing lamp, this location be memorized or marked before the machine is readjusted because the adjusting procedure requires usually a slackening of all threads and hence may cause a response of all drop wire switches.

Any such subsequent elimination of the selective indication is securely prevented in systems according to the present invention so that the operator will always know where the fault occurred regardless of a subsequent slackening of the threads. This result is achieved, without the necessity of using relays or the like auxiliary devices in addition to those required for the fault-controlled motor control performance, by interlocking the individual fault-controlled circuits of

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the system so that the first-responding circuit, when stopping the motor and causing the one appertaining signal to indicate, renders all other circuits inoperative and thus prevents a subsequent closing of other drop wire contacts or the like feeler elements from actuating additional signals.

These and other objects and features of the invention will be understood from the following description of the embodiment of a textile machine with drop-wire feeler contacts exemplified by the schematic illustration and circuit diagram shown in the drawing.

For the sake of completeness and in order to facilitate understanding the operation, examples of numerical values for the electrical components of the system are hereinafter given. These numerical examples are interrelated in referring all to a single embodiment of proved quality of performance. It should be kept in mind, however, that the ratings of the individual element and their proportion to one another may be varied within wide limits and that the values to be chosen will be determined by the requirements or desiderata of each particular application of the invention.

The illustrated textile machinery is schematically represented as having a creel type device with a number of yarn reels 1, 2, 3, 4 from which the yarn passes through a guide 5 onto a beam 6. The individual threads pass through the eyes of drop wire switches S1, S2, S3, S4 respectively whose contacts are kept open as long as the appertaining threads are unbroken and sufficiently taut. The beam 6 is driven by an electric motor M under control by a contactor C whose main contacts 7 and 8, when closed by the relay coil 9, connect the motor to the buses L1 and L2 of an alternating-current line. While the just-mentioned creel and beam device is characteristic of warping machinery, this particular type machinery is chosen merely for simplicity of illustration; and it should be understood that the invention proper, as embodied by the elements described below, is similarly applicable to other yarn, thread, strand or wire fabricating machinery.

The coil circuit of contactor C extends between buses L1 and L2 through a start contact B1 and a stop contact B2, both preferably designed as push-button switches. Further details of this coil circuit will be described in a later place. A back contact 10 of contactor C lies across the start button B1. Hence, when the start button is temporarily depressed by the operator, and

contactor C picks up to start motor M, the contact 10 closes a self-sealing circuit so that contactor C stays energized and motor M continues running until the stop button B2 is actuated or the coil circuit interrupted by the fault responsive devices now to be described.

Associated with the fault-responsive feelers on drop wire contacts S1, S2, S3, S4 are electromagnetic relays R1, R2, R3, R4 respectively. Relay R1 has two contacts 11 and 12 controlled by a coil 13. An indicator 14, for instance, a neon lamp (e. g., .5 watts) is connected across coil 13. An electronic trigger tube such as a thyratron (e. g., type No. 2050) has its plate circuit also connected across coil 13. The grid of tube 15 is connected through a resistor 16 (e. g. 1/4 megohm) with the drop wire contact S1. A capacitor 17 (.001 mfd.), a resistor 18 (2500 ohms), and a resistor 19 (10,000 ohms) are further associated with the tube and relay circuits appertaining to drop wire contact S1.

The tube and relay circuits associated with the other drop wire contacts are similar to those of contact S1. That is, the elements denoted by 21 through 29 and appertaining to drop wire contact S2, elements 31 through 39 appertaining to drop wire contact S3, and elements 41 through 49 appertaining to drop wire contact S4 correspond to the above-described elements 11 through 19 associated with drop wire contact S1.

The trigger tubes 15, 25, 35, 45 have their respective cathode heaters series connected in a heater circuit 50 which is energized by constant voltage (28 volts) from the secondary 51 of a transformer T whose primary 52 is connected to buses L1 and L2 through a main switch S. Another secondary 54 (130 volts) of transformer T is connected to the input terminals of a full-wave rectifier 55. A filtering or smoothing capacitor 56 (30 mfd.) lies across the output terminals of the rectifier. A negative output lead 57 and two positive output leads 58 and 59 are shown in the drawing. A voltage dividing resistance combination is connected across leads 57 and 59 and comprises three series-connected resistors 60 (25,000 ohms), 61 (3,000 ohms), and 62 (60 ohms). Interposed between the lead 58 and the positive rectifier terminal is the contact 63 of a relay FR whose coil 64 is series-connected in the heater circuit 50. A normally closed reset contact, preferably of the push-button type, is denoted by B3.

The above-mentioned coil circuit of the motor contactor M extends serially through the contacts 11, 21, 31 and 41. Hence, the motor M cannot be started unless all relays R1, R2, R3 and R4 are energized. To this end, the main switch S is first to be closed. This causes the transformer T to be energized. A rectified voltage now appears across leads 57 and 59. Simultaneously, the heater circuit 50 is energized. Relay FR picks up and closes its contact 63 so that the rectified voltage is also effective between leads 57 and 58. The voltage drop along resistor 62 is now impressed between the common cathode lead 65 of tubes 15, 25, 35, 45 and the respective grid circuits in such a manner that the tube of each grid is held on blocking potential as long as the appertaining responsive contact is open. As a result, all tubes are normally nonconductive. Coil 13 of relay R1 is now energized in the circuit:

58—18—13—65—62—57

Relay R1 picks up and closes contacts 11 and 12. Relays R2, R3 and R4 are energized in their analogous circuits so that contacts 21, 22, 31, 32, 41,

42 are also closed. The voltage drop now obtaining across the coils 13, 23, 33, 43 suffices to light the respective lamps 14, 24, 34 and 44. As long as all lamps are lit, the system is in condition for operating the motor M as described in the foregoing.

The feeler contacts S1, S2, S3, S4 have a common positive lead 66 which is connected, through relay contacts 12, 22, 32, 42, to a point 67 between resistors 60 and 61. When a fault occurs so that, for instance, feeler contact S1 drops out, it connects point 63 of the appertaining grid circuit with point 67. Consequently, point 63 changes its potential and becomes sufficiently positive, relative to the tube cathode lead 65, to cause firing of tube 15. The conductive tube 15 short-circuits the coil 23 so that relay R2 drops out and opens contacts 11 and 12. The opening of contact 11 interrupts the circuit of coil 9. Hence, contactor C drops out and stops the motor M. Lamp 14 goes out and thus indicates to the operator that the trouble started at feeler contact S1. Due to the opening of contact 12 in relay R1, the common positive lead 66 of all feeler contacts becomes disconnected from point 67 of the voltage divider. In consequence, all feeler switches become ineffective to fire the respective thyratrons so that a subsequent slackening of the threads due to the stopping of the machinery or as a result of any manipulation by the operator has no effect on the condition of the relay system. That is, tube 15 remains conductive, relay R1 dropped out, and lamp 14 dark while all other tubes remain non-conductive, all other relays picked up, and all other lamps lit. If any one of feeler contacts S2, S3, S4 drops out first, it causes firing of the appertaining tube so that the corresponding lamp will extinguish and the motor be stopped in the same manner as described above with reference to feeler contact S1. In any such event, the relay first responding brings about the disconnection of the feeler contact arrangement and thus secures a permanent selective indication, until the operator resets the system by opening the contact B3. This causes the thyratron then conducting to become deenergized and its corresponding relay to pick up again. If the fault is removed before the contact B3 is permitted to close its circuit, all the relays R1 through R4 will remain picked up with all thyratrons non-conductive, so that the motor M can be restarted by depressing the button B1.

Due to the fact that all tube filaments are connected in series with one another and in series with coil 64 of relay FR, this relay will cut-off the power supply to relays R1, R2, R3 and R4 and thus stop the motor M if any of the tube filaments burn out, if any one of the tubes gets loose in its socket, or if the filament voltage fails for any other reason.

Protection is also afforded if the main supply voltage fails because in this case the output voltage of the rectifier S5 becomes too low to hold relays R1, R2, etc. picked up. Hence, these relays will drop out and stop the motor.

While I have shown only four feeler contacts and four appertaining tube and relay arrangements, the invention can be used with any other number of fault-responsive elements of any kind, and these elements may be inter-connected to an equal number of tube and relay circuits, or the fault-responsive elements may be connected in groups to a smaller number of tubes and relays. In the latter case, the lamp appertaining to each relay and tube indicates the group of ele-

ments within which a yarn break is to be looked for after occurrence of a stoppage.

Other modifications and variations will be obvious to those skilled in the art. It should be understood, therefore, that the invention is not limited to the specific embodiment described in the foregoing but may be given a different design or used for other than the illustrated type machinery without departing from the above-explained principles and within the scope of the claims attached hereto.

I claim as my invention:

1. An indicating protective control system for machinery for fabricating strand material and the like, comprising a motor, a contactor for controlling said motor, a plurality of differently located control elements responsive to faulty condition of the material, a plurality of control assemblies having each an electromagnetic relay and an indicating means and including each a normally nonconductive electronic trigger tube in parallel connection to said relay, each of said relays having a contact and a relay coil for controlling said contact, an energizing circuit connected across said relay coils so as to cause said relays to be normally in picked-up condition and to drop out when said tubes are conductive, said tubes having respective grid circuits connected to said respective control elements so as to trigger said respective tubes when said elements respond to fault, circuit means disposed for providing trigger voltage for said grid circuits and having a circuit connection attached to said control elements and extending in series through said relay contacts so that when one of said elements has caused triggering of the appertaining one tube said control elements are rendered temporarily ineffective to thereafter trigger other tubes, said relays being connected to said contactor for controlling it to deenergize said motor when any one of said tubes is triggered.

2. In textile machinery for fabricating a multiplicity of threads, the combination of a drive motor, a contactor for controlling said motor, a multiplicity of fault responsive feeler contacts engageable by said threads, a multiplicity of control assemblies having each a normally nonconductive electronic trigger tube and including an electromagnetic relay and an indicating lamp controlled by said tube, said tube and said relay being connected in parallel to each other so that said relay is shorted when said tube is conductive, a direct-current circuit connected across said relays so as to cause them to be normally in picked-up condition, said tube having respective grid circuits connected to said respective control elements so as to trigger said respective tubes when said feeler contacts respond to fault, circuit means disposed for providing trigger voltage for said grid circuits and having a circuit connection attached to said contacts and controlled by said relays so that when one of said contacts has caused triggering of the appertaining one tube said feeler contacts are temporarily ineffective to thereafter trigger other tubes, said relays being connected to said contactor for controlling it to deenergize said motor when any one of said tubes is triggered so that then the indicating means pertaining to the triggered one tube indicates the fault location.

3. An indicating control system for machinery for fabricating strand material and the like, comprising a motor, a contactor disposed for controlling said motor and having a coil circuit, a plurality of control elements responsive to faulty

condition of the material, a plurality of control assemblies having each an electromagnetic relay and an indicating means and including each an electronic trigger tube for causing said relay and said indicating means to change their respective conditions when said tube is triggered, said tubes having respective grid circuits normally under cut-off bias and connected to said respective control elements so as to trigger said respective tubes when said elements respond to fault, circuit means disposed for providing trigger voltage for said grid circuits and having a circuit connection attached to said control elements and jointly controlled by said relays so that when any one of said elements has caused triggering of the appertaining one tube said control elements are rendered temporarily ineffective to thereafter trigger other tubes, said coil circuit extending in series through all said relays so that said motor can be operated only when all said tubes are nonconductive and is deenergized when any one tube is triggered.

4. An indicating control system for machinery for fabricating strand material and the like, comprising a motor, a contactor disposed for controlling said motor and having a coil circuit, a plurality of control elements responsive to faulty condition of the material, a plurality of control assemblies having each an electromagnetic relay and an indicating means and including each a normally nonconductive electronic trigger tube in parallel connection to said relay, each of said relays having two contacts closed in the picked-up condition of the relay, a direct-current circuit connected across said relays so as to cause them to be normally in picked-up condition and to drop out when said tubes are conductive, said tubes having respective grid circuits connected to said respective control elements so as to trigger said respective tubes when said elements respond to fault, circuit means disposed for providing trigger voltage for said grid circuits and having a circuit connection attached to said control elements and extending in series through one of said contacts of each of said relays so that when one of said relays drop out all control elements are temporarily ineffective, said other contacts of said relays being series-connected in said coil circuit so that said motor can be operated only when all said tubes are nonconductive and is deenergized when any one tube is triggered.

5. With machinery for fabricating yarn, thread, strand, wire and the like material, the combination of a motor for driving the machinery, a contactor for controlling said motor, a plurality of feeler contacts responsive to defects in material to be fabricated, a plurality of control assemblies having each an electro-magnetic relay and an indicating means and including each an electronic trigger tube, each of said relays having a normally closed relay contact and a coil for controlling said relay contact, said tube of each assembly being connected with the appertaining coil and with the appertaining indicating means for causing said coil and indicating means to change their respective conditions when said tube is triggered, said tubes having respective grid circuits normally under cut-off bias and connected to said respective feeler contacts so as to trigger said respective tubes when said contacts respond to fault, circuit means disposed for providing trigger voltage for said grid circuit and having a circuit portion connected to all said feeler contacts and extending serially through all said relay contacts so that when any one of said

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feeler contacts has caused triggering of the appertaining one tube all other feeler contacts are ineffective to thereafter trigger other tubes, said relays being connected to said contactor for controlling it to deenergize said motor when any one of said tubes is triggered so that then the indicating means pertaining to the triggered one tube indicates the fault location.

6. An indicating protective control system for machinery for fabricating strand material and the like, comprising a motor, a contactor for controlling said motor, a plurality of differently located control elements responsive to faulty condition of the material, a plurality of control assemblies having each an electromagnetic relay and an indicating means and including each a normally nonconductive electronic trigger tube in parallel connection to said relay, each of said relays having a contact and a relay coil for controlling said contact, an energizing circuit connected across said relay coils so as to cause said relays to be normally in picked-up condition and to drop out when said tubes are conductive, said tubes having respective grid circuits connected to said respective control elements so as to trigger said respective tubes when said elements respond to fault, circuit means disposed for providing trigger voltage for said grid circuits and having

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a circuit connection attached to said control elements and extending in series through said relay contacts so that when one of said elements has caused triggering of the appertaining one tube said control elements are rendered temporarily ineffective to thereafter trigger other tubes, said relays being connected to said contactor for controlling it to deenergize said motor when any one of said tubes is triggered, said tubes having respective cathode heaters, a heating circuit including said heaters in series connection with one another and having a relay connected with said energizing circuit for interrupting said energizing circuit in response to occurrence of current failure in said heating circuit.

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