

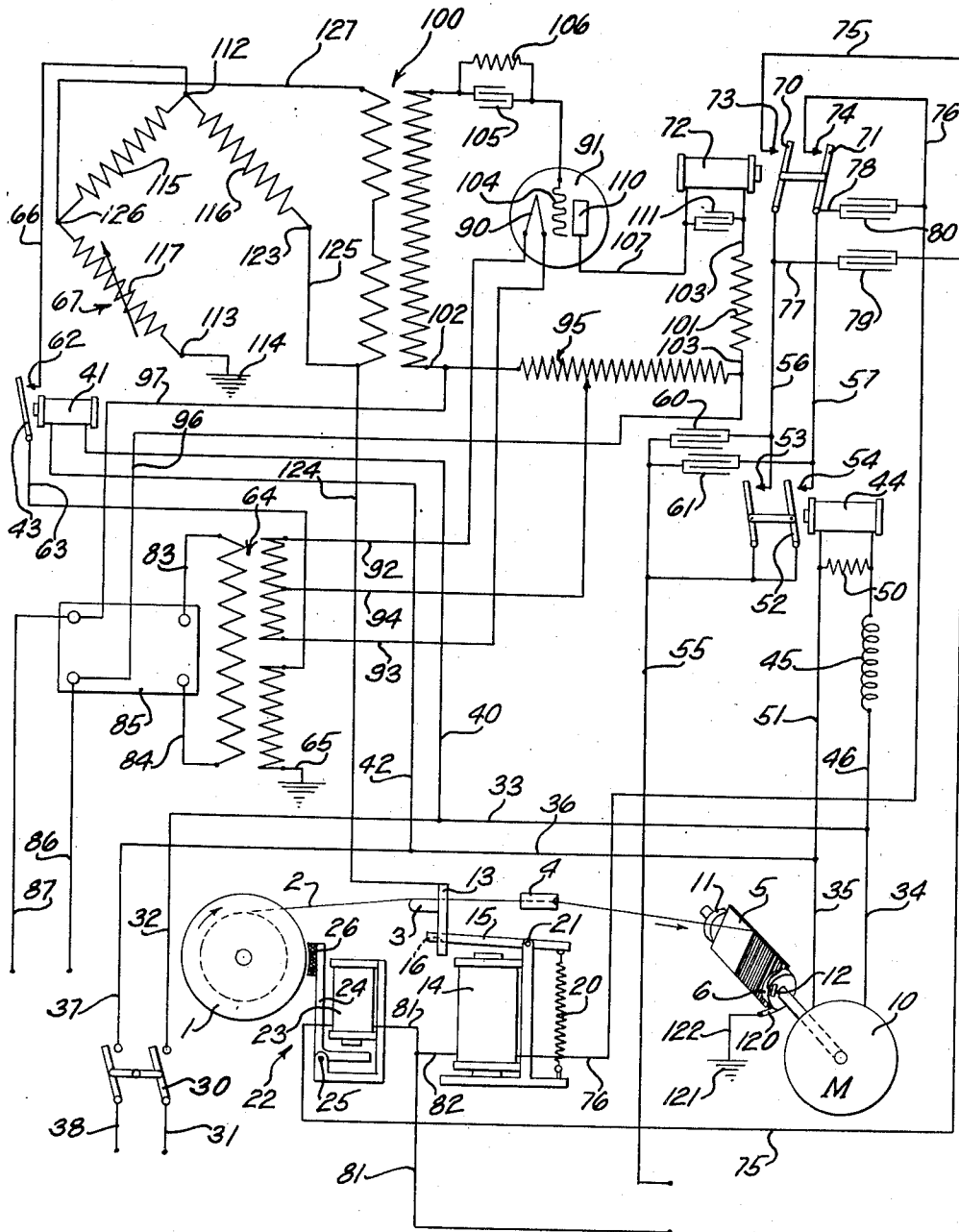
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CONTROL APPARATUS

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CONTROL APPARATUS

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This invention relates to control apparatus, and more particularly to apparatus for controlling the operation of coil winding machines.

An object of the invention is the provision of a simple and efficient measuring or controlling apparatus.

In accordance with one embodiment, the invention contemplates the provision of apparatus for winding resistance wire about a mandrel to form a resistance coil and simultaneously measuring the resistance of the coil by connecting it in an arm of a Wheatstone bridge circuit. When a predetermined amount of wire has been wound on the coil, the bridge circuit will be unbalanced in a direction opposite to its unbalance when less than the predetermined amount is wound thereon and current will flow from the bridge through a transformer to increase the voltage before directing it to the grid of a vacuum tube. The vacuum tube is of a type wherein if the grid voltage thereof is more negative than the plate voltage divided by the amplification factor of the tube no plate current will flow and if the grid voltage is less negative than this value the plate current is determined by the plate voltage and the resistance in the plate circuit.

The plate circuit of the vacuum tube is connected to a control relay which is effective to complete a circuit to an electromagnetically operated knife and an electromagnetically operated brake. Upon the reversal of the direction of flow of current across the bridge circuit the grid voltage will immediately become less negative than the plate voltage divided by the amplification factor of the tube thereby causing an amplified flow of current in the plate circuit of the tube and the consequent operation of the control relay, which will complete circuits to operate the knife and the brake, severing the strand which is passing under the knife and interrupting the rotation of the spool from which the strand of wire is being drawn.

A clear understanding of the invention will be had by reference to the following detailed description taken in conjunction with the accompanying drawing, wherein a single schematic view shows diagrammatically the features thereof and wherein like reference numerals designate the same parts.

The numeral 1 designates a supply spool from which a strand 2 of resistance wire is drawn over guides 3 and 4 to a rotating flat type coil base 5. The base 5 is positioned between a chuck 6 rotated by a motor 10 and a freely rotatable chuck 11. The forward end of the wire may be

attached to the chuck 6 by means of a clip 12 provided therefor.

A knife 13 cooperates with the guide 3 to form a shearing mechanism which is designed to be actuated by an electromagnet 14, the armature 15 of which engages a slot 16 in the knife. The armature is normally retained in the position shown by means of a spring 20 which tends to rotate it about a pivot 21 provided therefor. When the knife 13 is actuated to sever the wire, the spool 1 would normally continue to rotate due to its momentum so there is provided a braking mechanism therefor designated generally by the numeral 22 and comprising an electromagnet 23 having an armature 24 pivoted at 25 and carrying on an arm thereof a braking member 26 which, upon energization of the electromagnet 23, will engage the periphery of the spool and arrest its rotation.

The motor 10 is connected to a source of electromotive force by means of a double pole switch 30 which when closed completes a circuit from a line conductor 31 through conductors 32, 33, and 34 to the motor and from the motor through conductors 35, 36, and 37 back to the other side of the line at 38. In the particular embodiment of the invention disclosed herein, the conductors 31 and 38 are supplied with direct current at 110 volts.

When closed, the switch 30 also completes a circuit from the line conductor 31 through the conductor 32 and a conductor 40 to the winding of a relay 41 and through the winding of the relay, a conductor 42, and the conductor 37 back to the line at 38. The relay 41 will thus be energized simultaneously with the starting of the motor 10 and will attract its armature 43 to complete circuits to be described in detail hereinafter. A relay 44 is also connected to the conductors 33 and 36 and will be energized when the switch 30 is closed. This relay is made to respond slowly to the current supplied thereto by connecting an impedance coil 45 in a lead 46 connecting one side of the winding of the relay to the conductor 33 and by connecting a resistance coil 50 between the lead 46, at a point intermediate the impedance coil 45 and the relay 44, and a lead 51 which connects the other side of the winding of the relay 44 to the conductor 36. The relay 44, upon being energized, acts slowly to attract an armature 52 associated therewith and close two contacts 53 and 54 to connect a line conductor 55 to a pair of conductors 56 and 57, respectively. The conductor 55, in the particular embodiment disclosed herein, is connected

to a source of direct current at 48 volts. A pair of fixed condensers 60 and 61 are connected between the leads 56 and 57, respectively, and the line conductor 55.

5 When the switch 30 is closed manually the motor 10 will be started, the relay 41 will be energized, and immediately thereafter the relay 44 will close the contacts 53 and 54. The energization of the relay 41 will close a contact at 10 62 to connect a lead 63 running to one end of the secondary winding of a three winding transformer 64, the other end of which is connected to ground at 65, to a lead 66 connected to a Wheatstone bridge circuit designated generally by the numeral 67. The energization of 15 the relay 44 will connect the line conductor 55 through the conductors 56 and 57 to movable contacts 70 and 71, respectively, of a relay 72 which, upon being energized in a manner to be described more in detail hereinafter, will move 20 the contacts 70 and 71 into engagement with a pair of stationary contacts 73 and 74, respectively. Connected to the stationary contacts 73 and 74 are a pair of conductors 75 and 76 which are connected to one end of the windings of the electro- 25 magnets 23 and 14, respectively. Shunts 77 and 78 connect the conductors 56 and 57 to the conductors 75 and 76 through condensers 79 and 80, respectively. The other terminals of the windings of the electromagnets 23 and 14 are 30 connected through conductors 81 and 82 to the other side of the 48 volt direct current line. Thus, the energization of the relay 72 will cause the actuation of the electromagnets 14 and 23, which will thereupon sever the wire and stop 35 the rotation of the spool 1.

The transformer 64, which supplies electrical energy to the Wheatstone bridge circuit, has its primary winding connected by conductors 83 and 84 to the output of a voltage regulator 85 40 which is connected to line conductors 86 and 87 which supply 110-volt, 60-cycle alternating current thereto. This transformer also supplies current to a filament 90 of a vacuum tube 91 45 through conductors 92 and 93 connected to a secondary winding thereof, a lead 94 from which is connected to the movable contact of a potentiometer 95.

The potentiometer 95 is connected to the line conductors 86 and 87 by conductors 96 and 97, 50 respectively, which are in turn connected to one end of the secondary winding of a transformer 100 having a high impedance ratio and through a resistance 101 to the relay 72 by conductors 55 102 and 103, respectively. The other end of the winding of the secondary of the transformer 100 is connected to a grid 104 of the vacuum tube 91 through condenser 105 which is shunted by a resistance 106. The other end of the winding of 60 the relay 72 is connected by a conductor 107 to a plate 110 of a vacuum tube 91 and the conductors 103 and 107 leading to the relay 72 are connected through a condenser 111 which shunts the relay 72.

65 The circuit which applies the applied bridge voltage to the Wheatstone bridge is completed upon the relay 41 being energized from ground at 65, through the secondary winding of the transformer 64, conductor 63, armature 43 of the relay 41, conductor 66 to a point 112 on the 70 bridge, and across the bridge to a point 113 thereof which is connected to ground at 114. Arms 115 and 116 of the Wheatstone bridge 67 are of equal resistance, and arm 117 is of known 75 resistance and may be varied while the wire

between the guide 3 and the clip 12 forms the fourth arm of the Wheatstone bridge. To include the wire between these points in this arm of the bridge a brush 120 contacts with the chuck 6 and is connected to ground at 121 by a conductor 122 and the guide 3 is connected to a point 123 of the Wheatstone bridge by conductors 124 and 125. The point 126 on the bridge opposite the point 123 is connected to one end of the primary winding of the transformer 100 by a conductor 127 and the other end of the primary winding of the transformer 100 is connected to the point 123 by the conductor 125.

The apparatus and circuit for controlling the mechanism having been described in detail, a clear understanding will be had by referring to the following description of the operation thereof: The resistance of arm 117 is adjusted to that desired in the finished resistance coil, and a strand of wire 2 is drawn from the spool 1 and connected to the clip 12 on the chuck 6, passing over the guides 3 and 4 and under the knife 13, whereupon the switch 30 may be closed manually to start the motor 10. The closing of this switch will cause the relay 41 to be energized, immediately attracting its armature 43 to supply voltage to the Wheatstone bridge circuit 67. Shortly after the relay 41 operates the relay 44, which is also controlled by the closing of the switch 30, will be energized and will attract its armature 52 105 to close the contacts 53 and 54. The closing of the switch 30 and the consequent actuation of the relay 41 applies the voltage to the bridge circuit and may cause a switching transient current in the circuit as a whole, which will cause 110 the relay 72 to be operated momentarily. However, since the slow acting relay 44 does not close until an appreciable time after the relay 41 has attracted its armature, such a transient current will be dissipated before the circuits are completed to supply power to the electromagnets 14 115 and 23. Upon energization of the relay 44 power will be placed upon the open contacts 70 and 71 so that when the relay 72 is subsequently energized the brake 22 and the knife 13 will be actuated. The sense of the winding of the transformer 100 is such that the grid of the tube will be negative when the plate is positive provided the resistance of the coil under test is less than that of the arm 117. However, when the desired 125 amount of resistance is reached in the coil being wound the flow of plate current in the tube is established to cause the relay 72 to operate, whereupon the brake and knife will be actuated. While in the specific embodiment of the invention disclosed herein the coils being wound are formed of uninsulated wire, it is to be understood that coils of insulated wire might also be formed by simply adapting the apparatus described above so that a coil having a length of wire greater than necessary to form the resistance required could be wound and thereafter unwound and simultaneously scraped of insulation while in contact with a guide member similar to the guide member 3, appropriate changes in the circuit connections being made so that the plate current of the tube would begin to flow as soon as the resistance of the coil being measured became less than a predetermined amount rather than more than a predetermined amount as disclosed herein.

What is claimed is:

1. In apparatus for handling strand material, means for winding a strand, a Wheatstone bridge circuit, means for continuously including the wound strand as the unknown arm of the Wheat-

stone bridge circuit, a thermionic valve, means for establishing a flow of current in the plate of the valve under control of the potential in the grid of the valve and in response to a change in the direction of flow of current across the bridge, and means controlled by the thermionic valve for severing the strand when the resistance of the wound strand constituting the unknown arm balances the bridge circuit.

10 2. In apparatus for winding resistance coils, means for advancing a strand and winding it into a coil, a fixed contact member positioned adjacent the path of the strand during its advancement, a Wheatstone bridge circuit, means for including the portion of the strand positioned forwardly of the contacting member as an arm of the Wheatstone bridge circuit, a thermionic valve responsive to a change in resistance of the portion of the strand positioned forwardly of the contact member and operative upon a change in a direction of flow of the output voltage of the bridge, and means controlled by the thermionic valve for severing the strand when the resistance of the advanced strand constituting the unknown arm of the bridge circuit balances the bridge.

25 3. In a measuring apparatus, a winding arbor, a terminal upon the winding arbor for receiving the forward end of a strand to be wound upon said arbor, a cutting knife, a bridge circuit having three arms of known resistance, means for engaging the strand adjacent said cutting knife, means electrically connected to said strand engaging means and said terminal for continuously including the strand therebetween as the un-

known arm of the bridge circuit, and means actuated when the wound strand balances the bridge circuit for actuating said cutting knife for cutting the strand.

4. In a measuring apparatus, a supply spool of strand material, means for rotatably supporting said spool, a winding arbor for winding the strand from the spool, a terminal disposed upon said winding arbor for receiving the forward end of the strand, a cutting knife, a bridge circuit having three arms of known resistance, means for engaging the strand adjacent said cutting knife, means electrically connected to said engaging means and said terminal for continuously including the strand therebetween as the unknown arm of the bridge circuit, means actuated when the wound strand balances the bridge circuit for actuating the cutting knife for cutting the strand, a brake, and means for actuating said brake for stopping the rotation of said supply spool upon the actuation of said cutting knife.

5. In an apparatus for handling strand material, means for advancing a strand of material, a fixed material engaging member positioned adjacent the path of the strand during its advancement, a severing element positioned adjacent said member, means for measuring the resistance of the strand positioned forwardly of said member, and means controlled by said measuring means for actuating said severing element when the resistance of the measured strand has reached a predetermined value for severing the strand.

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