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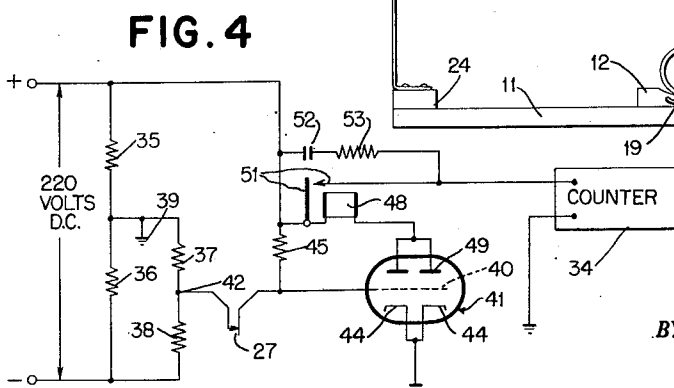
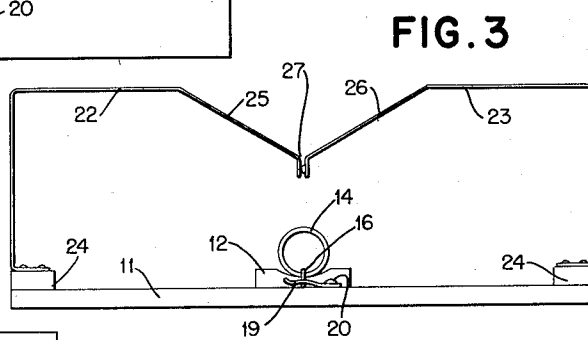
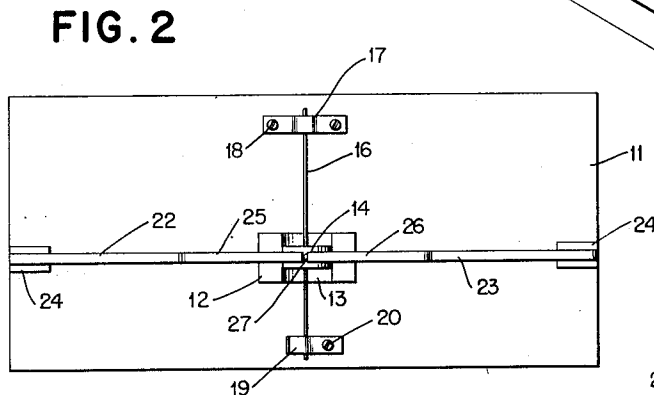
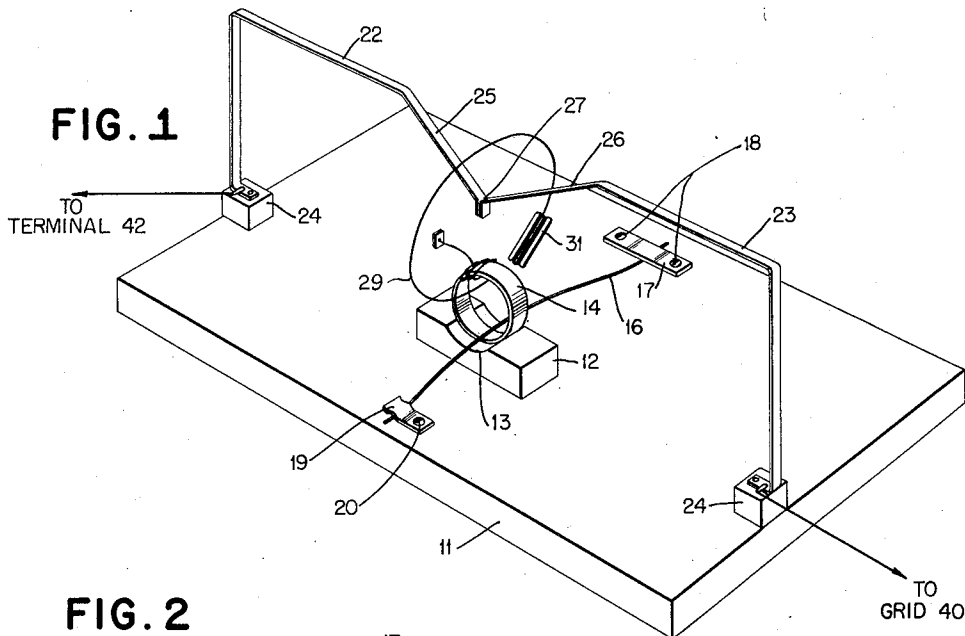
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2,812,136

CORE WINDING APPARATUS

Filed March 17, 1954

2 Sheets-Sheet 1



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FIG. 5

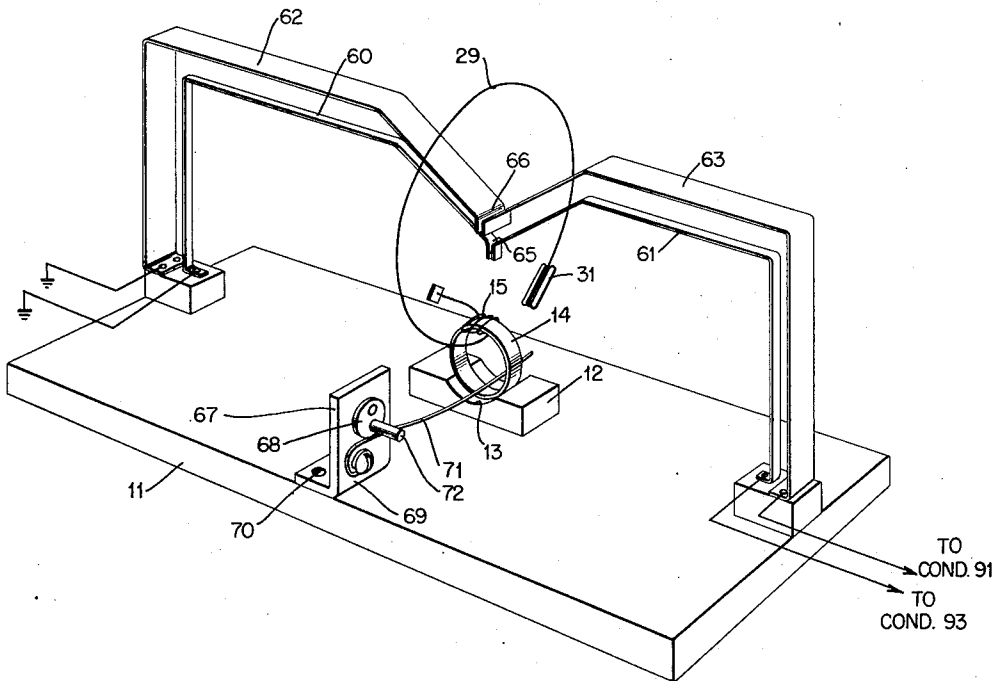
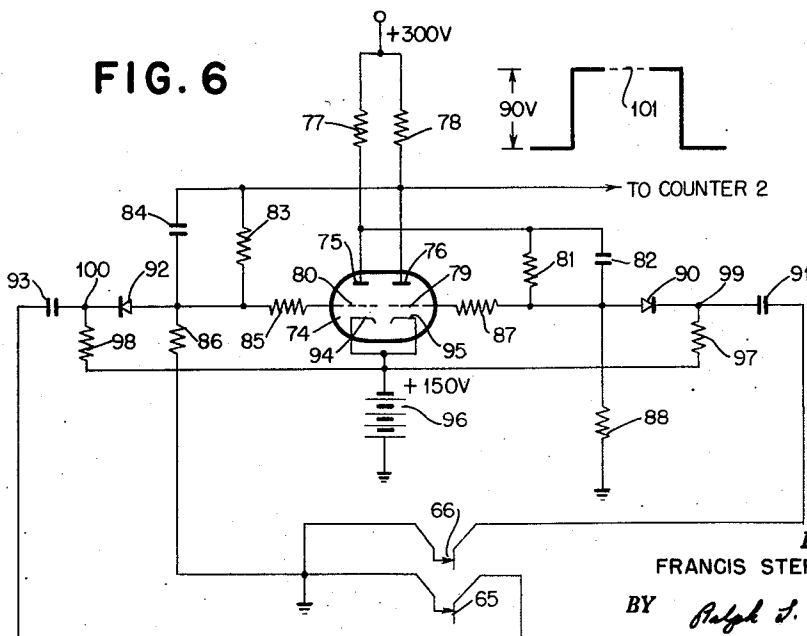


FIG. 6



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CORE WINDING APPARATUS

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7 Claims. (Cl. 235—92)

The present invention relates to an apparatus for automatically guiding turns of wire onto a toroidal core and maintaining an accurate count of the turns made.

More particularly, the present invention relates to an apparatus that employs members which serve to properly position wire turns on a toroidal magnetic core and also serve as an automatic electrical switch means for a counting device.

In the field of core winding, automatic machines are employed with great efficiency at low cost where a substantially large number of turns are made per core. Low cost and high efficiency are attributable in good measure to high speed operation of such automatic winding machines. Where it is desired to make a small number of turns per core, automatic machines tend to suffer a decrease in both efficiency and economy due partly to the fact that high speed operation cannot be fully utilized. It is, therefore, sometimes more economical to wind by hand those cores requiring only a small number of turns.

In the process of manually adding windings to a core, the problem of getting precisely the desired number of turns arises. Of course, an operator can keep track mentally of the number of turns. It is well known that where an operator works eight hours per day at the task of manually winding cores and mentally keeps track of the number of turns made, physical and mental fatigue result. Physical fatigue reduces the output whereas mental fatigue impairs the accuracy of the number of turns per core. Errors in the number of turns usually occur in multiple of ten. For example, where fifty turns per core are desired, mistakes most frequently result in windings having forty turns or sixty turns. Mistakes involving forty-seven turns, fifty-three turns or other similar numbers occur less frequently.

An object of the present invention is to provide an improved apparatus that is adapted for use in winding toroidal cores.

Another object of the invention is to provide an improved winding apparatus that automatically keeps an accurate count of the number of turns made.

A further object of the invention is to provide an improved winding device having a switch that avoids accidental operation.

A still further object is to provide a novel winding device that automatically and neatly places windings on a toroidal core.

Another object is to provide a novel winding device that compactly positions windings on a magnetic core.

Still another object is to provide a novel core winding device that will insure optimum performance when manipulated by an inexperienced operator.

Other objects of the invention will be pointed out in the following description and claims and illustrated in the accompanying drawings, which disclose, by way of example, the principle of the invention and the best mode, which has been contemplated of applying that principle.

In the drawings:

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Fig. 1 shows in perspective view one embodiment of the present invention.

Fig. 2 is a plan view of Fig. 1.

Fig. 3 is a side view of Fig. 1.

Fig. 4 is a schematic diagram of an electrical circuit and counter used in conjunction with the embodiment of Fig. 1.

Fig. 5 is a perspective view of a further embodiment of the present invention.

Fig. 6 shows a schematic diagram of a flip-flop circuit used in conjunction with the embodiment of Fig. 5.

Referring to Fig. 1, there is shown a base plate 11 on which is mounted a block 12 having a hollowed-out section 13 extending the width thereof. Mounted in the hollowed-out section 13 is a magnetic core 14 which is held in an upright position by a flexible metallic spring member 16 extending through the magnetic core and acting against its lower inside surface. Piano wire has been found suitable for this purpose. Member 16 is held in position by clamping one end to the plate 11 by means of a member 17 secured to the base plate 11 by two screws 18. This end of the spring member 16 may be permanently secured by any suitable means, if desired. The opposite end of spring member 16 is detachably secured to base plate 11 by means of a spring clip 19 which is attached at one end to the base plate by a screw 20. Upon swinging the end of the member 16 transversely from under the clip, the core 14 is released so that it may be removed from the spring member.

Spring contact members 22 and 23 are mounted on insulation blocks 24 at opposite ends of the plate 11 and have inclined guiding portions 25 and 26 which engage each other at a point overlying the mid-portion of the block 12 and act as a switch 27. These members must be made of material that has good spring characteristics as well as good electric current conducting qualities. Beryllium copper strips were found to give satisfactory results.

While the core 14 is supported in the position shown, turns of insulated wire 29 are placed upon it by passing a bobbin 31, attached to the wire, over the members 22, 23 and through the core as shown in Fig. 1. As bobbin 31 is pulled through the core, the wire 29 is guided first along the inclined portion 25 or 26 and then between their abutting ends to open the switch 27.

Referring now to Fig. 4, there is illustrated an electric circuit containing the switch 27 and operating to pulse a counter 34 each time that the switch is opened. A 220 volt source of direct current is applied across series connected resistors 35 and 36 which act as a voltage divider. Resistors 37 and 38 connected in series across resistor 36 comprise a further voltage divider which provides a negative bias voltage for grid 40 of a vacuum tube 41. A point in the circuit between resistors 35, 36 and 37 is connected to ground at 39. The junction 42 of resistors 37 and 38 is connected via the normally closed switch 27 to the control grid 40. Sufficient negative bias voltage is applied between grid 40 and cathode 44 of vacuum tube 41 to render it normally non-conductive. Vacuum tube 41 is shown as a twin triode with corresponding electrodes interconnected, but a single triode with suitable current capacity may be used. Grid 40 is connected by a resistor 45 to the positive terminal of the direct current voltage source. A relay coil 48 is connected between the positive terminal of the direct current voltage source and the anode 49. Relay contacts 51 are connected in series with the counter 34 between the positive terminal of the direct current voltage supply and ground. Counter 34 may be any conventional type that will advance in response to electrical pulses applied to the input. A condenser 52 and a resistor 53 are connected in series

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across the relay contacts 51 to prevent arcing when the relay contacts are opened and closed.

Since the switch 27 is normally closed, a negative bias potential is applied to the grid 40 for holding the tube 41 cut off. When the insulated wire 29 of Fig. 1 passes between the guide members 22, 23 and opens the switch 27, the grid circuit connection in Fig. 4 is broken. Grid 40 then has a positive potential applied thereto because of its connection to the positive terminal of the direct current power supply through resistor 45. This causes the tube 41 to become conductive and effect energization of the relay winding 48 which then closes the contacts 51 and completes a circuit from the positive side of the power supply through the counter to ground, thereby advancing the counter 34 one count. When the insulated wire 29 has passed between the abutting ends of members 22 and 23, the switch 27 in Fig. 4 is again closed to apply negative bias to grid 40 and render the vacuum tube 41 non-conductive. As the bobbin 31 is passed through the magnetic core 14 for each successive turn, the wire 29 must necessarily pass between the members 22, 23 and thereby advance the counter 34. In addition, each loop of wire is guided onto that part of the magnetic core 14 immediately under abutting ends of the members 22 and 23. With this novel arrangement, the turns of each winding are neatly and compactly positioned on magnetic core 14, and in addition an accurate count of the number of turns is constantly maintained. Neatness, compactness and accuracy of the number of turns for each winding are insured by means of this novel invention irregardless of whether the operator is experienced or not. The constant attention of the operator to details of properly placing the turns of each winding on the magnetic core and the mental operation of remembering the number of turns are dispensed with, thereby permitting an operator to complete a greater number of windings per day with less physical and mental fatigue.

Another embodiment of the invention is shown in Figs. 5 and 6 wherein the same reference characters used in Fig. 1 are used to designate like parts. In Fig. 5, two sets of contact members 60, 61 and 62, 63 are mounted on the base 11, as shown. The members 60, 61 are much smaller in width than the members 62, 63 and are mounted beneath the latter so as to form a switch 65 in vertical alignment with a switch 66 formed by the members 62, 63. In addition, a cam assembly 67 is used to replace the clip member 19 in Fig. 1 for detachably securing the core 14 to the block 12. An eccentric cam 68 is mounted on a support member 69 which, in turn, is secured to the base plate 11 by a bolt 70.

A spring member 71 is secured to support member 69 with sufficient bias normally to force itself upwardly. By means of a handle 72, the eccentric cam 68 is rotated to the position shown in order to hold the spring member 71 down against the inside surface of the core 14. To release the core, eccentric cam 68 is rotated to free the spring member 71 so that it moves upwardly from the position shown. By means of this novel arrangement, a fragile ferrite toroidal core can be readily and firmly clamped in the desired position or released without the likelihood of damage.

Reference is made now to Fig. 6 for a discussion of the circuit used in connection with the structure of Fig. 5. A flip-flop circuit is shown wherein a twin-triode tube 74 has its anodes 75 and 76 connected through resistors 77 and 78, respectively, to a +300 volt supply. Anodes 75 and 76 are cross connected to grids 79 and 80, respectively, by means of networks comprising R. C. circuits 81, 82 and 83, 84 serially connected with resistors 87 and 85, respectively. Grid 80 of the left half section of tube 74 is connected through series connected resistors 85 and 86 to ground, while grid 79 of the right hand section is connected through series connected resistors 87 and 88 to ground. A terminal point between resistors 87, 88 is connected through a diode 90 and a condenser

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91 to one terminal of the switch 66. The other side of switch 66 is grounded. Another terminal point between resistors 85 and 86 is connected through a diode 92 and a condenser 93 to one side of switch 65. The other side of switch 65 is grounded. Cathodes 94 and 95 are connected through a battery 96 to ground. Resistors 97 and 98 are connected between the positive terminal of the battery 96 and junction points 99 and 100, as shown.

A bistable trigger circuit or flip-flop derives its name from its characteristic mode of operation, i. e. first one tube is made conductive and then the other in response to some external control means. For example, if one tube is conducting, it will remain conducting until its grid is driven to cut off potential by some voltage usually applied from an external source. In the instant case, when the right half of tube 74 is conducting, the voltage of anode 75 will be approximately 300 volts positive and the voltage of anode 76 will be approximately 150 volts positive. Anode 75 is said to be up and anode 76 is said to be down. Since the anode of each section of tube 74 is cross-connected with the grid of the other section, it follows that when anode 75 is up, grid 79 is maintained at a positive value of voltage greater than cathodes 94 and 95 which keeps the right half of tube 74 in a state of conduction. Since the anode 76 is down, the voltage applied to grid 80 is sufficiently low to keep the left section of tube 74 cut off. Assume now that switch 66 is opened. The charge on condenser 91 will leak off due to inherent leakage resistance. The time necessary for condenser 91 to discharge is dependent on several factors, the most import of which are condenser size, inherent leakage resistance and quantity of charge. The time of discharge can be made any value desired by insertion of a resistor of proper value between ground and the junction point 99, but the discharge time was sufficiently fast that no such resistor was found necessary in this case. Assume now that switch 66 is closed. Condenser 91 presents a low impedance path to ground during recharge time. Consequently, the voltage at the junction 99 takes a sharp negative swing toward ground potential. The voltage on grid 79 follows at substantially the same potential except for a small voltage drop across diode 90 which makes grid 79 slightly more positive. This is inconsequential, however, since cathode 95 is maintained at 150 volts positive by battery 96 and grid 79 is now negative relative to cathode 95 by almost 150 volts. This negative swing in voltage on grid 79 causes the right section of tube 74 to cease conduction. The voltage on anode 76 rises to approximately 300 volts, and the voltage on grid 80 becomes highly positive since it is connected to anode 76 by resistors 85 and 83. As a result, the left section of tube 74 becomes conductive, and the voltage of anode 75 drops from 300 volts positive to about 150 volts positive. The voltages of grid 79 finishes its negative swing and builds back up to about 100 volts positive where it is held by the voltage divider network of resistors 81 and 88 connected from anode 75 to ground. Anode 75 now is down and anode 76 is up. If switch 65 is now opened and closed, a process occurs in the left half of the flip-flop circuit like that which occurred in the right half as explained above. Anode 76 is then down, and anode 75 is up. The starting point is reached, and the cycle starts over again. The cycle is repeated each time a turn is added to the core 14.

If desired, the cathodes 94 and 95 may be grounded and a 150 volt positive direct current source applied to anodes 75 and 76. By raising cathodes 94 and 95 up to 150 volts positive with battery 96 and anodes 75 and 76 up to 300 volts positive, grids 79 and 80 can exercise control at ground potential. Hence arcing at switches 65 and 66 is eliminated, and the operator may touch these switches without being subjected to electric shock.

In operation, when the insulated wire 29 passes between the abutting ends of members 62, 63 in Fig. 5, switch 66 is first opened and then closed. The circuit

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flips to conduction in the left section of tube 74. Anode 76 is, therefore, up and anode 75 is down, thereby establishing the leading edge of pulse 101 of Fig. 6. Wire 29 then passes between the abutting surfaces at switch 65, thereby opening and closing this switch to reset the flip-flop circuit. Anode 76 is now down and anode 75 is up, and the trailing edge of pulse 101 is established thereby terminating pulse 101.

The use of the two switch embodiment of Fig. 5 with the circuit of Fig. 6 provides greater assurance against the advancing of the counter by accidental opening of the switches. It is pointed out that accidental bumping of contact members 62 and 63, one or more times, cannot effect a false count, but this will set the flip-flop to conduction in the left half section of tube 74. A count is not effected until switch 65 is opened and closed after the switch 66. Members 62, 63 serve the further function of shielding the members 60 and 61. Contact members 62 and 63 are several times greater in width than members 60, 61 and serve as an interposing shield for protecting against an accidental opening of the switch 65.

While there have been shown and described and pointed out the fundamental novel features of the invention as applied to a particular embodiment, it will be understood that various omissions and substitutions and changes in the form and details of the device illustrated and in its operation may be made by those skilled in the art, without departing from the spirit of the invention. It is the intention, therefore, to be limited only as indicated by the scope of the following claims.

What is claimed is:

1. An apparatus for guiding and counting turns of wire as it is manually wound upon a core comprising, in combination, a base support member, means for detachably securing a core in an upright position on said support member, separate metallic members mounted on opposite ends of said base support member and extending inwardly across the latter to a point adjacent said securing means where said metallic members abut each other to form an electric switch means said metallic members having portions inclined toward their abutting ends for guiding turns of wire upon said core, electric circuit means including at least one vacuum tube for producing an output pulse in response to operation of said switch means, means connecting said metallic members in said circuit at the input of said tube whereby interruption of the input is initiated for each turn of wire passing between said metallic members, an electrically operated counter, and means operating in response to output pulses from said tube for energizing said counter.

2. An apparatus for counting turns of insulated wire as it is manually wound upon a core comprising, in combination, a support member, means for detachably securing said core in an upright position on said support member, contact members mounted upon said support member and engaging each other at a point over said core, the wire moving between said contact members to separate them when each turn is made, an electrically operated counter, and circuit means connected to said contact members and said counter, said circuit means operating upon the separating of said contact members for energizing said counter.

3. A manual core winding apparatus comprising a base member, means on said base member for detachably securing a core in an upright position, separate current conductive leaf members on said base member separably abutting each other and forming a V, the point of the V being adjacent to said securing means and forming a guide for wire to be wound on a core, electric circuit means having an input and an output, an electrically operated counter connected to said output, and means connecting said leaf members to the input of said electric circuit means, said circuit means operating upon the pass-

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ing of wire between the abutting ends of said leaf members for energizing said counter.

4. In an apparatus for adding turns of wire to a magnetic core, a pair of guide members, a base plate, each guide member of said pair being mounted on said base plate to separably abut each other, securing means on said base plate for detachably securing a magnetic core adjacent the abutment of said guide members, an electric circuit including a unilateral conducting device with at least one control electrode, a source of bias potential connected through said guide members to said control electrode to maintain said unilateral conducting device normally non-conductive, counter means connected in the output circuit of said unilateral conducting device; whereby each turn of wire guided onto a magnetic core by said guide members passes between the abutting guide members to change the magnitude of said source of bias potential on said control electrode to such value that said unilateral conducting device is rendered conductive and said counter means advanced one count.

5. In a core winding apparatus for putting wire turns on a core, a vacuum tube circuit including anode, control and cathode electrodes, a switch, a source of negative bias potential, said source of negative bias potential being connected to said control electrode by said switch, said switch comprising two flexible metallic leaf members positioned to separably abut each other, a base plate with said leaf members mounted thereon, core holding means positioned on said base plate to thereby hold a core in position adjacent the abutting part of said leaf members, counter means connected in the anode portion of said vacuum tube circuit, whereby said leaf members serve to guide wire turns onto a core and perform as a switch to remove said negative bias potential from said control electrode to thereby actuate said counter means and maintain an accurate count of the number of turns in a winding.

6. In an apparatus for winding wire on a magnetic core, a flip-flop circuit, said flip-flop including first and second unilateral conductive devices each having a control electrode, first and second switch means connected in the control electrode circuit of said first and second unilateral conductive devices, respectively, a base member, said first and second switch means including first and second pairs of flexible metallic strips, respectively, said flexible metallic strips in each pair being mounted to separably abut each other, a saddle positioned adjacent said abutting parts of said metallic strips, said first pair of metallic strips being wider than said second pair of metallic strips and positioned adjacent said second pair, said second pair of metallic strips being mounted nearer said base than said first pair, counter means connected to said first unilateral conductive device; whereby said first pair of metallic strips shields said second pair of metallic strips from accidental interruption, guides a wire turn onto said second pair of strips, and interrupts the control electrode circuit of said first unilateral conductive device to set the flip-flop; said second pair of metallic strips guides a wire turn onto a core and interrupt the control electrode circuit of said second unilateral conductive device to flip the flip-flop circuit, energize said counter and maintain an accurate count of the number of turns made.

7. In a core winding apparatus, a base member, a first pair of flexible leaf members positioned on said base member to separably abut each other, a second pair of flexible leaf members positioned on said base member to separably abut each other, said second pair of flexible leaf members being mounted in parallel relationship with said first pair and being located between said first pair and said base member, means for detachably holding a core adjacent the abutting portions of said flexible leaf members, a flip-flop circuit including first and second vacuum tubes each having a control grid, said first and second pairs of flexible leaf members being connected in the control grid circuit of said first and second vacuum tubes, respectively, counter means connected to the output of

said first tube, whereby a wire turn is guided by said first pair of flexible leaf members onto said second pair of leaf members and the flip-flop is set to conduction in said first vacuum tube as the abutting portion of said first pair of flexible leaf members is momentarily separated; 5
said second pair of flexible leaf members guiding the wire turn onto a core, flipping the flip-flop to conduction in said second vacuum tube as the abutting portion of said second pair of flexible leaf members is momentarily separated, thereby energizing said counter means to effect a 10 count.

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