COIL CONSTRUCTION AND METHOD OF MAKING THE SAME

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This invention relates to a coil construction and method of making the same and more particularly to a construction embodying a plurality of pancake or pie windings and method of making such construction which eliminates the above disadvantages. A new coil embodying the present invention makes it possible to have as many pie windings as may be desired, all connected together physically as one integral construction with readily available connection for the interior parts of every pancake winding forming the entire coil.

In order that the invention may be understood, it will now be explained in connection with the drawings where-in:

Figure 1 shows a perspective view of a transformer having coils embodying two modified forms of the invention;

Figure 2 is a perspective view showing the beginning of winding of one coil embodying the present invention;

Figure 3 is an end view of a finished coil embodying one form of the present invention;

Figure 4 is a diagrammatic view of a part of a winding machine illustrating the beginning of winding of a number of coils embodying one form of the invention;

Figure 5 is a transverse sectional view of a completed coil embodying one form of the invention;

Figure 6 is a diagrammatic view of a winding machine illustrating the beginning of the winding operation for coils embodying a modified form of the invention;

Figure 7 is an end view partly in section illustrating the completed coil embodying a modified form of the invention.

Figure 8 is an enlarged detail of the coil of Figure 7;

Figure 9 is an end view similar to Figure 7 but showing a further modification.

Referring first to Figure 1, there is shown transformer 10 having conventional laminated core 11 and coils 12 and 13. Coils 12 and 13 may form the primary and secondary windings respectively of the transformer, it being immaterial which is the primary and which is the secondary. Both coils are shown as embodying two modifications of the invention for the sake of illustrating these two modifications. It is, of course, possible to have only one coil embodying the invention and have the other coil of conventional construction.

Coil 12 may be made up of any number of pancake windings and as shown here, consists of four pancake windings 15 to 18 inclusive. Similarly, coil 13 may be made up of any number of pancake windings and consists of windings 20 to 23 inclusive.

It is understood that transformer 10 is conventional as far as the core is concerned and the manner in which the coils are assembled upon the core.

Referring now to Figures 2 to 5 inclusive, a detailed description of one form of the invention, together with a method for winding a coil embodying one form of the invention, will follow.

This invention makes it possible to follow closely conventional coil winding practice. Thus a number of coils are wound by first starting with form 25. This form consists generally of a paper or cardboard tube, usually of generally rectangular cross section. Thus the completed coil can be slipped over the correspondingly-shaped magnetic core.

Form 25 is long enough so that a substantial number of separate coils can be wound in tandem. Form 25 is slipped over mandrel 26 of a winding machine, mandrel 26 having its ends supported in suitable bearings. The mandrel is driven by suitable means, this being conventional in the art and not being described or shown.

As shown in Figure 4, form 25 is long enough to accommodate four sets of complete coils in tandem. This number is merely exemplary and it is understood that the number of coils wound in tandem may be less than or greater than the four shown. It is also understood that each coil as shown on the drawings consists of four pancake windings. The number of pancake windings on the respective coils may be the same or may be different and this may be less than or greater than shown in the drawing.

Referring specifically to Figure 4, coils 27 to 30 inclusive are shown as being formed. Thus specifically
referring to coil 27 as an example, this is made up of four pancake windings 31 to 34 inclusive. The dotted lines indicate the dividing line between the opposed sides of the pancake windings, these sides being formed by the end planes of the end turns of the winding. In practice, paper between superposed layers of wire would extend beyond these planes. Hence, the dotted lines indicate the limits for the wire turns for each pancake winding.

Between coils 27 and 28 is dotted line 36 which forms a dividing line between adjacent coils along which cutting occurs when after the windings have been formed and adjacent coils are to be sawed apart, it is understood that the cutting will take place along line 36 and similar lines between adjacent coil ends. The procedure with respect to the individual turns of the winding is the same as for the remaining coils so that the description will proceed in detail for coil 27 except where other coils are specifically referred to.

Pancake windings 31 to 34 inclusive, forming coil 27, are themselves formed by winding wires 31a to 34a inclusive. These wires pass through suitable guide rolls and tensioning means from individual spools, all this being generally known in the winding, machine art and requiring no detailed description. Wire 31a and the corresponding wire in the remaining coils 28 to 30 inclusive, will be at the end of the coil after the various coils have been sawed or cut apart.

Assuming that the winding is initially from left to right—this, of course, may be reversed—wire 31a may be held in a conventional manner. Thus wire 31a then be turned around form 25 several times to provide a length of lead. If the wire is too fine, the end of wire 31a may be soldered to a heavier lead wire and this lead wire may be twisted around form 25 as desired. Thereafter, a sheet of insulating paper may be started around the entire length of form 25. It is understood that this insulation sheet may be outside of the few initial turns of wire 31a and the corresponding wires at the left end of each of the remaining coils.

However, wire 31a may be handled in a manner similar to wire 32a.

Disposed at any desired side of form 25 are elongated conducting strips 31b and 32b. These conducting strips are preferably flat but may have any shape and extend the full length of form 25. The thickness and width of each conducting strip will depend upon the size of the pancake winding, the amount of current to be carried by the conductor strips, the condition of the core and various other factors. In general, however, conducting strips 31b and 32b may be of copper or brass and should be heavy enough so that soldering is possible. Wires 31a and 32a and the corresponding wires in remaining coils 28 to 30 inclusive are soldered to their respective strips.

In order to maintain the conducting strips in position temporarily, adhesive strips 31c and 32c may be disposed on the opposite surface of the conducting strips and extend beyond the side of the conducting strips so as to contact the insulating surface beneath them. Thus strips 31c and 32c will function as insulators for the top surfaces of the conducting strips and at the same time anchor the same on the form or whatever is over the form.

Instead of strips 31c and 32c, tabs of adhesive paper may be disposed at spaced intervals to anchor the conducting strips for other fastening means may be used. It is possible to terminate the conducting strips at the wires for coil 30 and not extend the conducting strips to the very end of this coil. It is preferred, however, to have the conducting strips extend the full length of all the coils in order that the various wire layers may be wound in a uniform fashion. Furthermore, the capacitance between this strip and the remaining windings for each of the conducting strips in all the coils and the strip will be equally accessible at the two ends of each coil.

In order that the wires to be soldered to the conducting strips be located promptly on such strips, it is possible to have each conducting strip and its adhesive retainer prepared at the same time with the tape to a suitable slot at the proper point on the winding strip.

Pancake winding 33 is handled in a similar fashion by providing conducting strip 33b extending the full length of form 25 but along a different side of the form. This side may conveniently be the side following as the form is rotated for normal winding. For convenience, strip 33a is supplied with adhesive tape 33c and this tape is slit or perforated at a suitable point as shown to line up with the corresponding conducting strip. Pancake winding 33 is similarly handled by providing conducting strip 34b together with its tape 34c on still another side of the form. Wires 33a are soldered to a suitable spot upon strip 34b, this spot being advantageously indicated by a notch in the conducting strip or a notch in the adhesive tape or both. The remaining wires for the remaining coils are similarly handled.

After the conducting strips are properly anchored, one or more layers of sheet insulation 38 of paper or the like may be wound over the form by rotating the same as during normal winding, the various wires being fed out over the paper. Thereafter, normal winding of the various coils proceeds. As will be readily understood, even during the provision of one or more turns of sheet insulation, all the wires are fed out simultaneously so that every winding of every coil has the same number of turns. As winding proceeds, it is clear that any one or more pancake windings of any one of more of the complete coils can be provided with intermediate conductor strips as desired. The outer terminals for the windings may be handled in a conventional manner.

The conductor strips for the length of all the coils may generally be the same length as all the coils in tandem or may be somewhat longer so that the starting end of the left-hand coil in this particular instance has the conducting strips present prior to the left-hand end of the right-hand coil, or paper or coil proper. It will be apparent that the conductor strips will be flush with the sides of the coils after they are sawed apart. Since the ends of the windings are distinguished by the presence of the insulating strip, it will be possible to spread the ends of the paper to expose the raw end of the conducting strips and solder a lead wire thereto. Figure 1 shows leads on the conducting strips. If desired, the metal connector strips may have suitable apertures near the paper edges so that a lead may be inserted therein and be anchored securely.

As illustrated in Figures 1 to 5 inclusive, one conductor strip is disposed on each side of the coil except two strips for wires 31 and 32 in coil 27 and the corresponding wires for the remaining coils. These conductor strips may be as wide and as heavy as may be desired. In case a coil is large enough to accommodate a number of conductor strips in side by side relation along the same part of the coil, it may be simpler to wind such coils. Thus for example, as shown in Figures 6 and 10 to 13 inclusive, one conductor strip is disposed on each side of the form upon which all coils are to be wound. As shown here, end wire 57a is temporarily cemented at 57a on form 25 or may be permanently provided prior to the application of the conductor strips or may be wound about the application of the conductor strips. It is understood that wires corresponding to 57 in the remaining coils will be similarly handled.

In Figures 6 to 8 inclusive, the conductor strips, to which wires 58a, 59a and 60a are respectively connected, are disposed on one side of the coil form.

Preferably one or more location 70 are provided between adjacent wire layers. Each of the conductor strips is provided with the adhesive tape as shown so that the conductor strips are anchored. As is shown, the wires are soldered to the conductor strips at proper points on the windings. When every winding for every coil has thus been taken care of, normal winding is initiated and all the coils are accordingly wound in tandem. The treatment for the windings otherwise may be the same as for the windings shown in the previously described figures.

Referring to Figure 9, it is possible to provide conducting strip 57a with its adhesive cover strip 57c for wire 57a and the corresponding wire at the left end of coils 51, 52 and 53. Hence, every interior wire end will have its own separate having strip. Conducting strips may be provided for the outer winding terminals, if desired. Other modifications will occur to those skilled in the art.

What is claimed is:

1. A coil construction for transformers or the like
comprising a form extending the entire length of said coil, a plurality of windings in tandem on said form, each winding having an inner and outer end and having superposed wire layers separated by sheet insulation, the sheet insulation extending continuously for the length of the coil but the wire layers extending only for the length of the winding in which the layers are disposed, the corresponding ends of the windings where the inner ends of the windings lie constituting the starting ends of the windings, the coil as a whole having a starting end for one winding at one end of the coil, said coil having another winding at the other end of the coil, a conducting member for at least each of all windings other than the one winding, each conducting member being straight and lying lengthwise of the form for the full coil length and being disposed between the outside of the form and the innermost layer of each winding, the inner end of a winding being connected to the corresponding conducting member, the entire coil having accessible at the two ends thereof lead connections to otherwise inaccessible inner ends of the other windings and any additional windings which may lie between the one and other windings, and connections for the outer ends of all windings.

2. As an article of manufacture, a plurality of coils joined end to end, each coil having the construction according to claim 1, the form, sheet insulation and conducting members extending throughout the length of the plurality of coils and forming the joining means between the adjacent coil ends.

3. The construction according to claim 1 wherein at least one additional conducting member is provided, said additional member lying between adjacent wire layers where an intermediate winding tap is to be provided and extending the full coil length, the wire for the particular winding to be tapped being connected to said additional member.

4. The method of tandem winding a number of coils simultaneously, each coil itself consisting of a number of tandem windings, said method comprising providing a winding form of suitable length, laying on said form lengthwise thereof for the full length thereof a number of straight conducting members, there being one conducting member for the inner ends of corresponding windings in the coils, connecting the corresponding starting ends of wires to said members so that one conducting member is connected to the starting ends of corresponding windings in the coils, tandem winding the wires to form the coil windings, separating adjacent wire layers by sheet insulation which extends for the length of said form and continuing the winding operation until the outer ends of the windings are reached.

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