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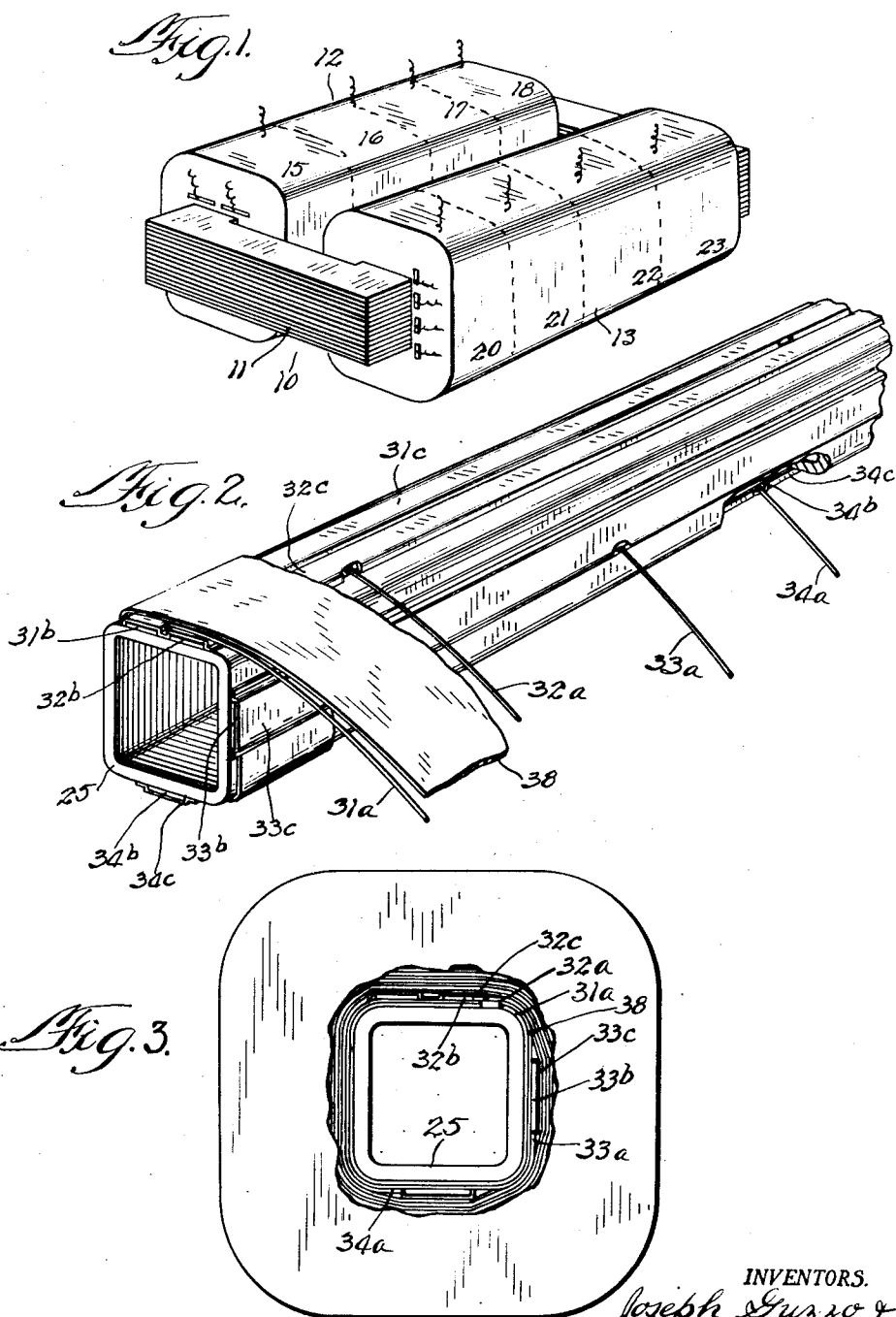
J. GUZZO ET AL

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COIL CONSTRUCTION AND METHOD OF MAKING THE SAME

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3 Sheets-Sheet 1



INVENTORS.
Joseph Guzzo &
Arni Helgason.
By Robert L. Kalin *Att'y*

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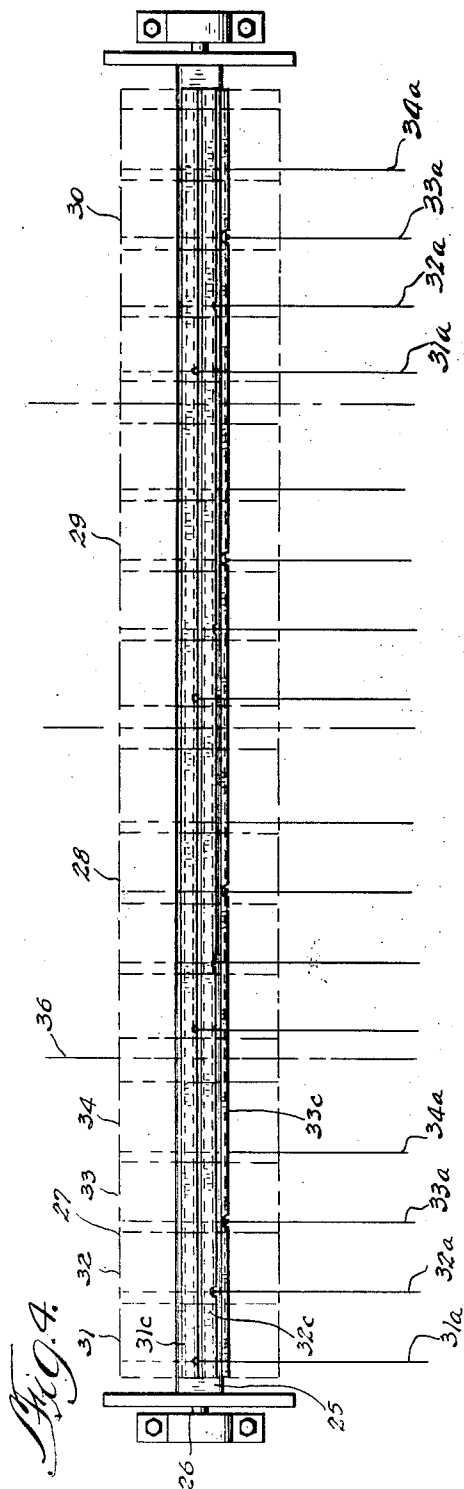
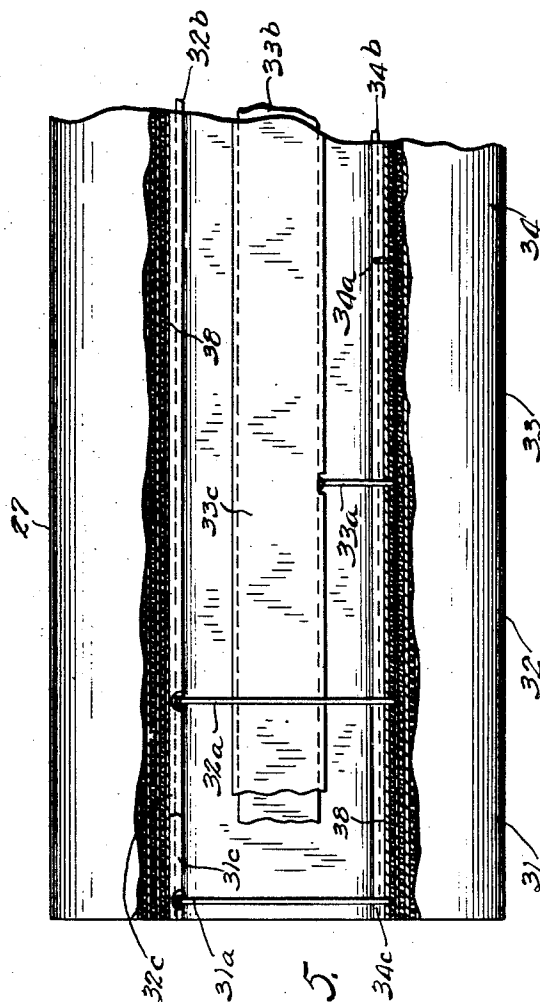
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INVENTORS
Joseph Guzzo &
Arni Helgason.
By Robert L. Kalne *Att'y*

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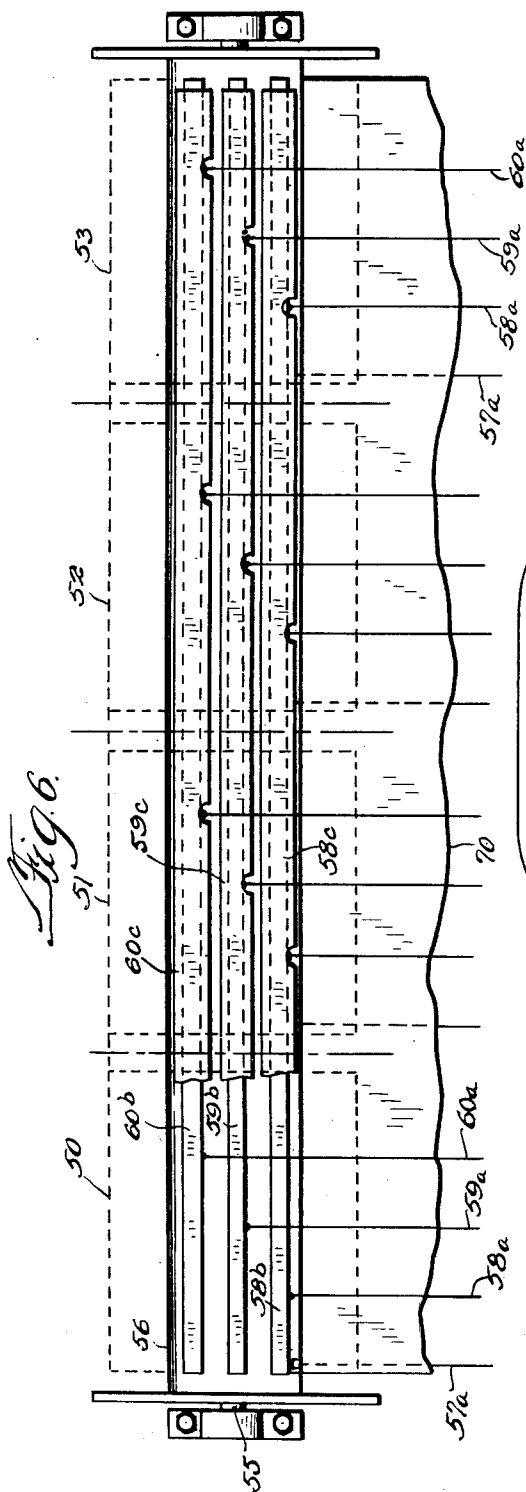
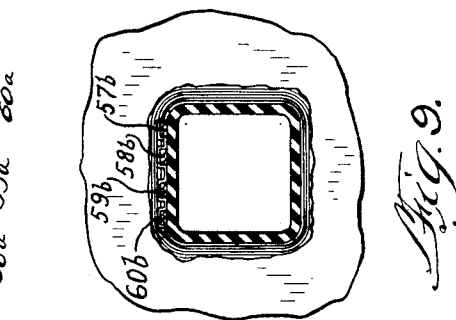
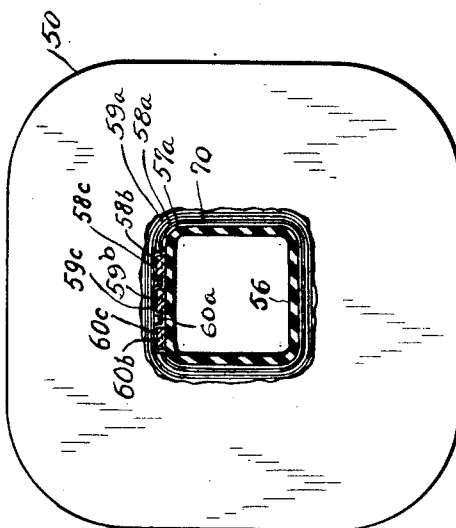
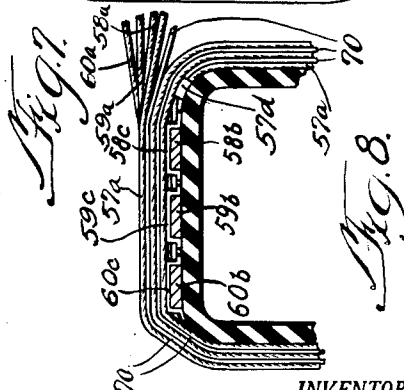
J. GUZZO ET AL

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COIL CONSTRUCTION AND METHOD OF MAKING THE SAME

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3 Sheets-Sheet 3



INVENTORS.

Joseph Guzzo &
Arni Helgason.

By Robert L. Kahn *Att'y.*

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2,706,280

COIL CONSTRUCTION AND METHOD OF MAKING THE SAME

Joseph Guzzo, Chicago, and Arni Helgason, Wilmette, Ill., assignors to Essex Wire Corporation, Cook County, Ill., a corporation of Michigan

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4 Claims. (Cl. 336—182)

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 the same. In certain types of transformers, it is necessary to divide the primary or secondary, or both, into a number of separate windings or units. This expedient becomes necessary when the distributed capacitance of coils is to be reduced or is necessary for other reasons. It has always been the practice to make each pancake winding in a conventional manner, each such winding being physically and electrically separate from the other windings. Thereafter, a number of such windings are disposed in side by side relation on a magnetic core and suitable connections made between them as desired.

It is desirable to integrate a number of such pancake windings for one coil into one unitary physical structure while retaining the electrical identity of each winding distinct from the other windings in a coil. With such an integral construction, the same insulating material is more effective. A coil consisting of a number of pie windings may be handled easier and more economically. Furthermore, a unitary coil consisting of a predetermined number of pie windings is desirable since the separate pie winding cannot be misplaced or reversed. In addition, the unitary physical structure of the coil reduces the mechanical vibration between windings occurring at audio-frequencies when currents of sufficient magnitude pass through the windings.

The method of making the new coil as hereinafter described results in manufacturing economies in addition to providing an improved product. The new method insures uniformity of turns and layers in all pie windings and makes accidental differences impossible.

The invention here relates to a coil and a method of making such a coil wherein the insulating portion of all of the windings may be integral and common while the conducting portions of the windings are electrically separate and distinct.

The invention in general provides for winding in tandem any desired number of pie windings for any desired number of coils. As used herein, a coil will be considered as made up of a number of electrically separate but physically integral pie windings. The invention makes it possible to provide such windings without in any manner limiting the availability of any parts of the pie windings, or connection to other parts of other pie windings, or to outside circuits.

It is old to wind a number of windings in tandem and thereafter saw the windings so that each such winding is physically separate from other windings. In such case, no difficulty is experienced in locating the inside and intermediate leads of a winding for connection to other windings or to outside circuits. As a rule, such leads of a winding are located simply by probing at the sides of the winding and pulling the wire out for use.

Where a number of pancake or pie windings are physically intact although electrically isolated to form a coil, provision for making electrical connection to the inside or intermediate parts of all of the windings must be provided. One end winding of such an integral structure containing a number of pie windings may have the inner end and intermediate terminals or leads located in conventional manner by probing at the sides. Assuming that every pie winding is started similarly from one side of each winding, it is clear that only one end winding of a coil may thus be handled. The same procedure is

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inapplicable to the remaining pie windings since the inner end and intermediate ends will be inaccessible.

In accordance with this invention, a construction is provided and a method of winding is provided 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 wherein:

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 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 adjacent 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 merely 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. Thus 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 pancake windings for coil 27 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 each 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 handled in a conventional manner. Thus wire 31a may 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, the gauge of wire to be soldered later to the conductor strips for connection purposes 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 over the conducting strips and extend beyond the sides 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 to the form or 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 coil will be uniform in all the coils and the strips 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 ahead of time with the tape having a suitable slot at the proper point on the conducting 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 33b is supplied with adhesive tape 33c and this tape is slotted or apertured at a suitable point as shown to line up the point for connection to wire 33a.

Pancake winding 34 is similarly handled by providing conducting strip 34b together with its tape 34c on still another side of the form. Wire 34a is 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 various 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 or 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 projecting beyond the sides of the windings and 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 as distinguished from the paper will be beyond the paper edge, it will be possible to spread the edges 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 Figure 6, coils 50 to 53 are being wound in tandem. Coil 50, as an example, consists of pancake windings 57, 58, 59 and 60 wound from correspondingly numbered wires with subscript a. Conductor strips 58b, 59b and 60b are disposed in spaced parallel relation along one side of the form upon which all coils are to be wound. As shown here, end wire 57a is temporarily cemented at 57d on form 25 or may be wound a few times on the form prior to the application of the conductor strips or may be wound after 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 sheets of insulation 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 57b 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 conductor 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

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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

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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.

References Cited in the file of this patent

UNITED STATES PATENTS

644,311	Anderson	Feb. 27, 1900
649,086	Varley	May 8, 1900
865,907	Jodrey	Sept. 10, 1907
1,713,941	Adams et al.	May 21, 1929
1,968,600	Driftmeyer	July 31, 1934