June 21, 1932. I. N. WHITESMITH 1,864,331

ELECTRICAL COIL

Filed Nov. 13, 1930

Fig. 1.

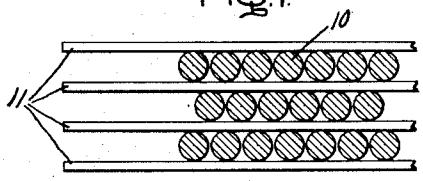


Fig. 2.

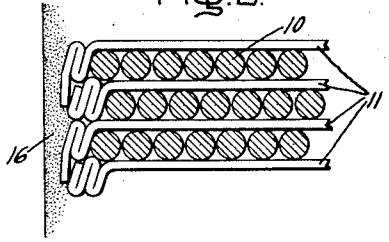


Fig. 3.

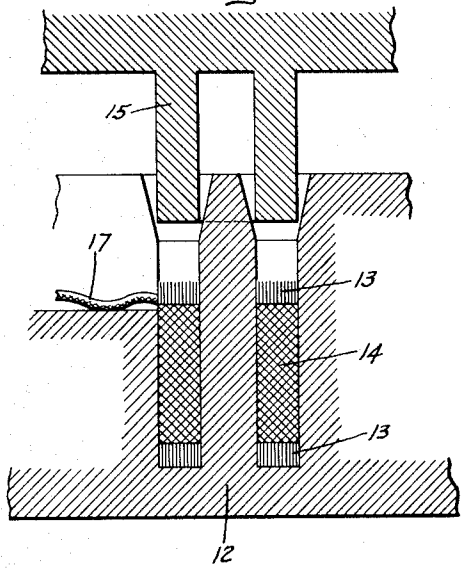
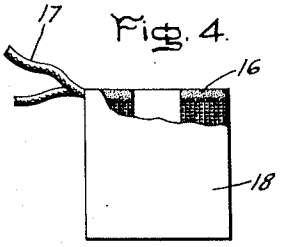


Fig. 4.



Inventor:
Isaac N. Whitesmith,
by Charles E. Mullen
His Attorney.

Patented June 21, 1932 1,864,331

UNITED STATES PATENT OFFICE

ISAAC NEWTON WHITESMITH, OF URMSTON, ENGLAND, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK

ELECTRICAL COIL

Application filed November 13, 1930, Serial No. 495,465, and in Great Britain November 30, 1929.

My invention relates to electrical coils, more particularly to electrical coils such as are used in electrical instruments, voltage or current transformers, radio applications and the like, and has for its object the provision of an improved coil of this character and method of making it.

Electrical coils are commonly wound on a former consisting of a tube of paper or other insulating material provided with flanged ends so as to form a bobbin, and when the coil is provided with paper or other sheet insulation between the layers it is usually necessary to leave a space of at least $\frac{1}{16}$ of an inch between the wire and the flanges in order that the wire forming one of the end turns of any particular layer may not become displaced and make contact with a wire in another layer of the winding and thereby incur the risk of a breakdown of insulation owing to an unduly high potential difference existing between the two wires; the actual length of the coil is therefore increased beyond that which is actually necessary to contain the desired number of turns of wire.

In making a coil in accordance with the present invention, the wire is wound upon a tube without end flanges and the several layers in the coil are separated by paper or other suitable sheet insulating material which serves to hold the wire in place and extends to a distance beyond each end of the layers.

At the ends of the coil thus formed in the interstices between the ends of the sheets of the paper an insulating material in powdered form, which is capable of being moulded by heat under pressure such, for instance, as a powdered resin of the phenol-formaldehyde type, is sprinkled and then the ends of the paper are compressed being folded up and crinkled with the powder filling the crevices. The coil thus prepared is inserted in a mould which is closed and heat applied to consolidate the powder. The mould which is used in consolidating the powder may be employed for compressing the ends of the paper. The leads from the coil can be led out through slots provided in the mould for that purpose. By this means the coil is formed with solid ends or cheeks which, by regulating the quantity of mouldable powder employed, may be as thick as desired.

In the improved coil manufactured as above described space is economized as a clearance between the end turns of each layer and the end flanges is not required, the layers of insulation are held securely by their ends and the turns of the winding are held firmly in position.

The sheet insulation employed in winding the coil must be such as will stand the temperature required for moulding the material forming the ends. Conveniently, paper either untreated or varnished with a solution of a resin of the phenol-formaldehyde type may be employed or cloth untreated or treated with this solution for heavier wires.

In order that the nature of my invention may be clearly understood an example of how the same may be carried into practical effect will now be described in some detail with reference to the accompanying drawing in which: Fig. 1 is a diagrammatic sectional view showing a portion of the end turns of a coil with the associated sheet insulating material after it is wound; Fig. 2 is a similar view, but illustrates the same at a later stage in the manufacture; Fig. 3 is a section of a mould in which the powdered insulating material can be consolidated by heat under pressure, the coil being illustrated in position in the mould; and Fig. 4 is a diagrammatic elevation of a completed coil, parts being broken away to illustrate certain details of the construction of the coil.

In making the coil in accordance with my invention the wire is wound with insulating sheet material, paper or insulating cloth for example, between the layers, but the layers of wire do not extend to the edges of the paper. This is clearly indicated in Fig. 1 wherein the end turns 10 of three layers of a conductor are shown in section, together with sheets of paper insulation 11 interposed between adjacent layers, the edges of these sheets projecting beyond the end turns, as is clearly shown on the left-hand side of the drawing. It will be understood that the coil may be thus wound by hand, or may be wound in any suitable winding machine (not shown).

After the required number of turns have been wound, powdered insulating material, which is capable of being consolidated by heat under pressure, such as that having as a base a phenolic condensation product, is sprinkled in the interstices of the paper at the two ends of the coil.

The coil is then put in an annular mould indicated at 12 in Fig. 3 in which the edges of the paper at each end of the coil are shown at 13, the wire wound portion being indicated at 14; and an annular plunger 15 is forced down by a press so as to compress the edges of the paper with the insulating powder therebetween somewhat as indicated in Fig. 2, in which 16 indicates the powdered insulating material.

The mould is then closed and heated to the proper temperature to consolidate the insulating material after which the coil is removed and appears somewhat as shown in Fig. 4. The ends of the winding are led out at 17 and the coil may be covered with paper or cloth or other material on the outside as indicated at 18.

If desired the coil may be covered with moulded insulated material on the outside as well as at the ends by providing space in the mould at the outside and inside of the coil for holding the insulating powder.

It will be observed that in the completed coil the moulded insulating material forms the flanges which are close to the end turns of the wire, all of which are held firmly in position.

While I have shown a particular embodiment of my invention, it will be understood, of course, that I do not wish to be limited thereto since many modifications may be made, and I, therefore, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:—

1. The method of making an electrical coil which comprises winding the turns of said coil on sheet insulating material so that the end portions of said sheet insulating material project beyond the end turns of said coil and then compressing the projecting portions of said sheet insulating material inwardly toward said turns and compacting said compressed portions with an insulating material so as to form flanges for said winding.

2. The method of making an electrical coil which comprises winding the turns of said coil on sheet insulating material so that the end portions of said sheet insulating material project beyond the end turns of said coil, applying to the end portions of said coil a mouldable insulating material, and then compressing said projecting end portions inwardly toward said layers of turns and moulding said insulating material about said compressed end portions so as to form end flanges for said coil.

3. The method of making an electrical coil which comprises winding each layer of turns of said coil on a sheet of insulating material so that the end portions of said sheet project beyond the layer of turns wound thereon, applying to the end portions of said coil thus formed an insulating material having the characteristic of assuming a moulded form upon the application of heat and pressure, subjecting said winding to pressure so that said projecting end portions and said insulating material are compressed inwardly toward said layers of turns and then applying heat to said winding so as to mould said insulating material whereby said compressed end portions are secured and said end portions together with said moulded insulating material form end flanges for said coil.

4. The method of making an electrical coil which comprises winding each layer of turns of said coil on a sheet of insulating material so that the end portions of said sheet project beyond the end turns of the layer wound thereon, applying to the end portions of said coil thus formed powdered insulating material which is capable of being consolidated by the application of heat and pressure, applying pressure so as to compress said projecting end portions and to compact said powdered insulating material about said compressed portions and then applying heat while the pressure is maintained so as to mould said insulating material whereby said compressed end portions are secured and said end portions together with said moulded insulating material form end flanges for said coil.

5. The method of making an electrical coil which comprises winding each layer of turns of said coil on a sheet of insulating material so that the end portions of each sheet project beyond the end turns of the layer wound thereon, filling the interstices between said projecting end portions with a regulated quantity of powdered insulating material which has the characteristic of assuming a moulded form when subjected to pressure and heat, subjecting said winding to pressure so as to press said projecting end portions inwardly toward the said end turns of said layers and to compact said powdered insulating material within the crevices of and about said compressed end portions, and then applying sufficient pressure, and heat at a sufficiently high temperature to cause said powdered insulating material to assume a moulded form.

6. The method of making an electrical coil which comprises winding each layer of turns of said coil upon a sheet of insulating material so that the end portions of each sheet project beyond the end turns of the layer wound thereon, applying to the projecting end portions and to the surfaces of the coil

thus formed an insulating material possessing the characteristics of assuming a moulded form upon being subjected to heat and pressure, then subjecting said coil to pressure so that the projecting end portions of said sheet insulating material are pressed inwardly toward the wound layers of said coil and then subjecting the coil to heat and pressure so as to mould said insulating material about said coil.

7. The method of making an electrical coil which comprises winding each layer of turns of said coil on a sheet of insulating material so that the end portions of said sheet project beyond the layer of turns wound thereon, applying to the end portions of said coil thus formed an insulating material having the characteristics of assuming a moulded form upon the application of heat and pressure, subjecting said coil to pressure so that said projecting end portions and said insulating material are compressed, then applying heat to said coil so as to mould said insulating material, and then covering said coil with a protective cover.

8. An electrical coil comprising a conductor wound into a plurality of layers, each layer being wound on a sheet of insulating material, the end portions of which are compressed and compacted in an insulating compound so as to form end flanges for said coil.

9. An electrical coil comprising a conductor wound into a plurality of layers, sheets of insulating material interposed between said layers, said sheets being longer than said layers and having their end portions compressed inwardly toward said layers and an insulting material moulded about said compressed end portions so that said insulating material together with said compressed end portions form flanges for the end turns of said layers.

10. An electrical coil comprising an electrical conductor wound into a plurality of layers, sheet insulating material interposed between said layers, each sheet being longer than its associated layer and having its end portions compressed inwardly toward the end turns of said layer, and an electrically insulating compound compacted about said compressed end portions so that said insulating compound together with said compressed end portions form flanges for the end turns of said layers and an electrically insulating compound compacted about the remaining surfaces of said coil.

In witness whereof, I have hereunto set my hand this 27th day of October, 1930.

ISAAC NEWTON WHITESMITH.