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PROCESS FOR MANUFACTURING COIL COMPONENTS AND TRANSFORMERS

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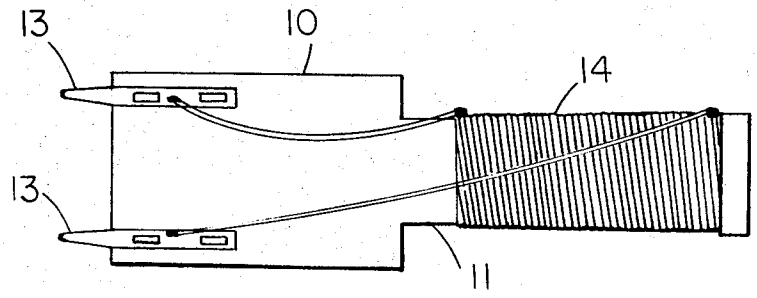


FIG. 1

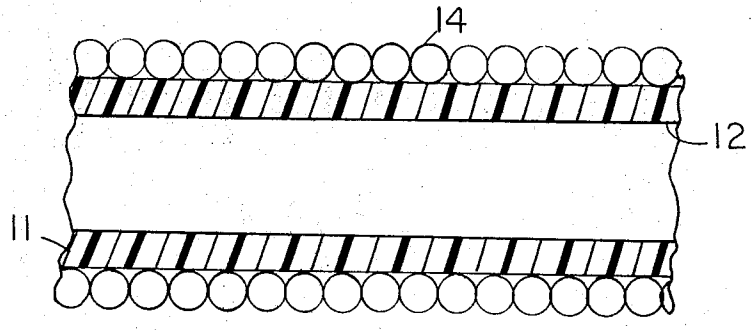


FIG. 2

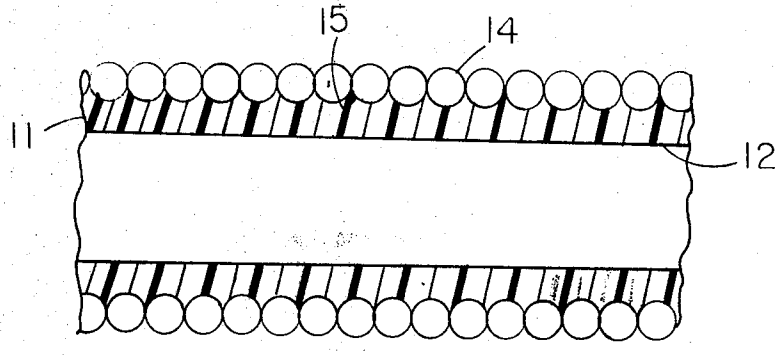


FIG. 3

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PROCESS FOR MANUFACTURING COIL COMPONENTS AND TRANSFORMERS

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7 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a unique process for manufacturing the coil component of a small transformer such as an RF transformer used in electronic equipment. Specifically, the process involves the steps of helically winding a strand of wire about a cylindrical member, the surface of which comprises a thermo plastic. The wire is held under positive pressure and heated in situ by means of an electric current applied thereto. During the resulting heating and cooling cycle, a continuous helical groove is formed in the said surface to receive and uniformly space the wire about the cylindrical member.

BACKGROUND OF THE INVENTION

While this invention has particular application to RF transformer used in receivers of communication equipment, it will be apparent to those skilled in the art that this invention is applicable to other and related equipment. However, for convenience, this invention will be described with respect to the production of RF transformers. For a more detailed discussion of the arrangement and function of such a transformer, reference is hereby made to copending application Ser. No. 748,126, now U.S. Pat. No. 3,437,968, a continuation-in-part application of SN. 656,841, now abandoned, each filed in the name of Albert R. Hildenbrandt.

Small transformers of the type to which this invention is applicable comprise one or more coils, each having a core capable of axial adjustment within the surrounding coil. The core is disposed within the bore of a cylindrical non-conductive coil form and the coil is wound about said coil form.

Heretofore, one of the problems in the performance of such coils, one directly attributed to the manufacturing operation, was an undesirably high drift. A further problem has been the inability to maintain the transformer in a tuned condition. In an effort to overcome these problems, the prior art has attempted numerous ways whereby the coil is fixed in relationship to the nonconductive coil form. One method was to apply an adhesive or a wax to hold the wire in a fixed position relative to the coil form. However, due to the high water absorption characteristic of the holding materials, moisture was picked up during use which affected the dielectric properties and frequency of the transformer.

Due to the obvious limitations of such prior art methods. attempts were made by mechanical means to set the coil on the coil form. One such method was the application of nipples or heat sealing elements located at the lateral extent of the helically wound coil. That is, when the coil was wound taut on the coil form, a hot iron or the like was applied to the members to mesh them down over the ends of the wire to hold the coil in place. Initially, this solved the problem. However, due to the inherent expansive properties of the wire and the coil form, and as a result of extended use of the transformer, the wires tended to shift within the limits of the heat sealing elements, as a consequence, the same problems arose.

In a further attempt to fix the wires against relative movement on the coil form or support member, a continuous helican groove was molded or cut into said coil support member to receive the windings therein. This procedure was not, however without its shortcomings. Such a procedure was costly and precluded the changing of the pitch with respect to the wires. Further, the resulting device was limited in the size of wire which could be employed. Finally, mechanical limitations of the system made it difficult to get close grooves about the coil support.

It was not until the development of the present invention that the foregoing performance problems, as well as the mechanical shortcomings, were overcome in an economic manner. That is, it was now possible to prepare transformers of the type described herein offering an unlimited choice in wire size and pitch.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is an elevational view of a coil component of a transformer manufactured in accordance with the process as taught herein.

FIG. 2 is an enlarged fragmentary cross-sectional view of the device shown in FIG. 1 at an intermediate step in the process of this invention.

FIG. 3 is a view similar to FIG. 2, but taken from a device sectional subsequent the process taught herein.

DETAILED DESCRIPTION OF PREFERRED EBODIMENT

A transformer component, upon which the present invention is applicable, consists of an enlarged base portion **10** and a coil supporting portion **11**. Each of said portions are characterized by a bore **12** extending throughout the length of the component. Projecting from and secured to the end of portion **10** are a plurality of terminal lugs **13**, to which the ends of the coil **14** are attached. Typically, the bare component shown in FIG. 1 is manufactured from nonconductive material, the selection of which is limited only to the extent to be described hereinafter.

In the manufacturing of such transformer components, a support (not shown) is inserted into the bore **12** prior to the winding of the coil **14**. It will become apparent from the process which follows that the support has a dual function, namely: (1) provide support to maintain the shape of the component, and (2) act as heat sing during the heating step. With the transformer component firmly supported, a helical winding of a suitable conducting metal is wound about the coil support portion **11** in the manner illustarted in FIG. 1.

With the ends of the coil **14** held taut, an electric current is applied thereto raising the temperature of the wire so as to soften the surface of the coil support portion **11** lying beneath the surrounding coil **14**. FIG. 2 illustrates the smooth surface of the coil support member prior to the heating step, whereas, FIG. 3 illustrates the scalloped surface subsequent the heating step.

As indicated above, the material from which the component is manufactured is a non-conductive material. In the present case, the surface at least must be a thermo plastic. Such materials are well known in the art; however, examples of the latter are polypropylene and polyethylene. While it may be possible to have a composite structure, i.e., a nonconductive core such as glass or compressed paper, with a coating of thermal plastic, it is more convenient to utilize the same material throughout. Hence, the further description will be limited to the discussion of a unitary structure primarily for the ease of understanding. Thermo plastics as used herein should be distinguished from the materials known as thermal-set

plastics. The former materials are characterized by the capability of being remelted and solidified without destruction to its original properties, the latter are not so characterized.

While applicant does not intend to be bound by any stated theory as to the reasons for the success of the operation, it is believed that during the heating cycle of the process the coil of wire is caused to expand an amount greater than the expansion on the surface of coil support portion **11**. Consequently, with the cooling that results after the heating step, the coil is believed to contract at a more rapid rate causing it to imbed slightly in the softened surface of portion **11** producing a helical groove **15** thereabout. This procedure produces a very distinct scalloped profile on portion **11** and corresponding in pitch to the helical windings **14**. Due to the many variables to be considered, such as the material about which the wire is to be wound, the number of turns and the type of wire, no single current values or times can be assigned to this process. However, it can be stated that sufficient current, without damaging the wire, must be used to generate enough heat to soften the surface of the coil support portion **11** in contact with the windings **14**.

The following is an exemplary embodiment of the process of this invention. A coil component such as shown in FIG. 1 was molded from polypropylene, manufactured under the name Pro-Fax by the Hercules Power Company, Inc., Wilmington, Delaware. The coil support portion had a diameter of approximately 290 mils and was wound with 100 turns of No. 38 copper wire, such wire having a resistance of approximately 5 ohms. With the ends of said wire held taut, a current of about 2 amps for approximately 2 seconds was applied thereto. The resulting structure found the wire slightly imbedded within the coil support which had a scalloped profile with a short pitch equal to the pitch of the wound coil.

It should be apparent to those skilled in the art that certain modifications may be made to the description and example as noted above. While there are certain inherent limitations that will dictate restrictions herein, it is expected that changes in the current applied, the time in which the current is applied, and the materials employed will be found thereby permitting certain flexibilities in the process. Further, the manufacturing of the components may be further modified to the extent that the current may be applied through the terminal lugs located at one end of the coil component. Therefore, in view of the foregoing changes and suggestions, no limitation is intended to be imposed herein except as set forth in the appended claims.

The embodiments of the invention in which an exclusive property or privilege is claimed are defined as follows:

1. A process for manufacturing a coil component for use in electrical devices, comprising the steps of winding a length of electrically conductive wire about a cylindrical member whose surface is smooth and comprises a thermo plastic, said electrically conductive wire being characterized by rates of expansion and contraction which exceed that of said thermo plastic, maintaining the position of the wire on said member by holding the wire ends taut, therafter applying heat to said wire by the application of electrical current thereto, said heat causing the softening of said thermo plastic and the expansion of said wire, removing said heat and permitting said wire to contract about said cylindrical member whereby the wire is embedded in the thermo plastic.

2. The process claimed in claim **1**, wherein said thermo plastic is selected from the group consisting of polypropylene and polyethylene.

3. The process claimed in claim **1**, wherein said cylindrical member is molded from polypropylene.

4. The process claimed in claim **3**, wherein said cylindrical member is provided with a bore extending throughout the length thereof, and including the step of supporting said member by means of an arbor received in said bore during the heat generating step.

5. The process claimed in claim **4**, wherein said strand is helically wound about said cylindrical member subsequent the supporting thereof.

6. The process claimed in claim **5**, wherein said period of time is approximately 2 seconds.

7. The process claimed in claim **5**, wherein said wire is imbedded in the surface of said member as a result of said heat generating step.

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