United States Patent [19]

Lazor

[11] **3,710,293**

[45] **Jan. 9, 1973**

[54] INSULATING MEMBER FOR TRANSFORMER COILS

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[73] Assignee: **Westinghouse Electric Corporation**, Pittsburgh, Pa.

[22] Filed: **March 30, 1972**

[21] Appl. No.: **239,532**

[52] **U.S. Cl.**.....**336/198**, 336/206

[51] **Int. Cl.**.....**H01f 27/30**

[58] **Field of Search**.....336/196, 198, 206, 209, 208

[56] **References Cited**

UNITED STATES PATENTS

3,189,681	6/1965	Feather	336/206 X
3,351,693	11/1967	Feather et al	336/209 X
2,354,500	7/1944	Camilli	336/209
2,489,853	11/1949	Britten	336/206
2,754,355	7/1956	Bartlett	336/206 X
2,435,093	1/1948	Mitschrich	336/209 X

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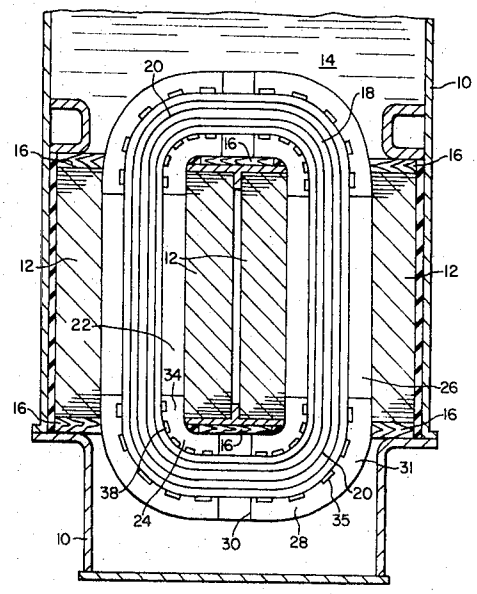
[57] **ABSTRACT**

U-shaped channels extend around the edges of the coils of shell-form power transformers. The channels are constructed of layers of crepe paper and pressboard with at least one layer of crepe paper separating adjacent layers of pressboard. An adhesive is used to bond the layers together. In one embodiment, the edges of the channels are scarfed to form a scarfed joint with an adjacent channel.

4 Claims, 5 Drawing Figures



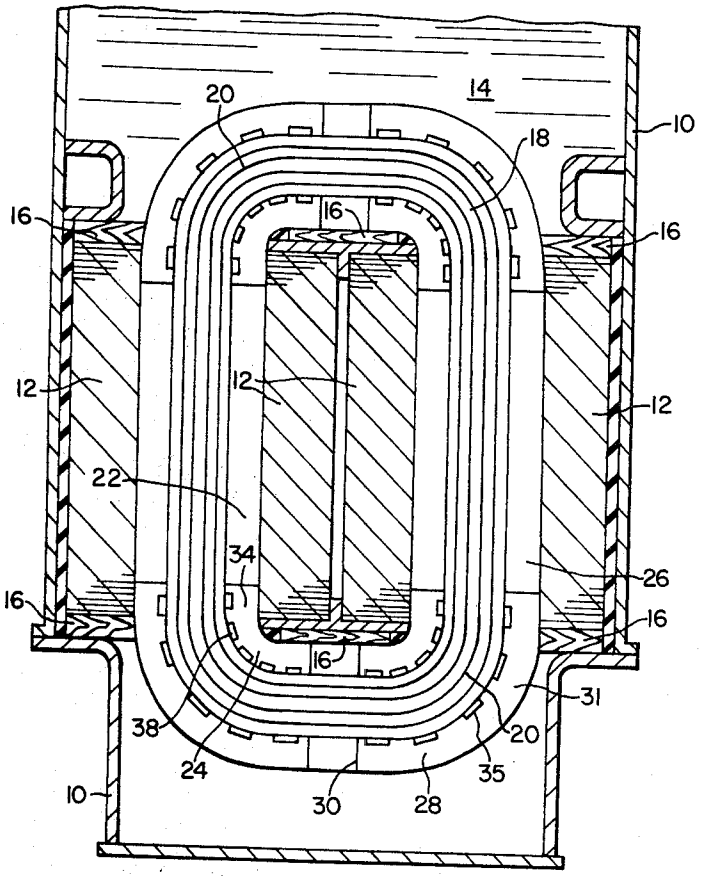


FIG. 1.

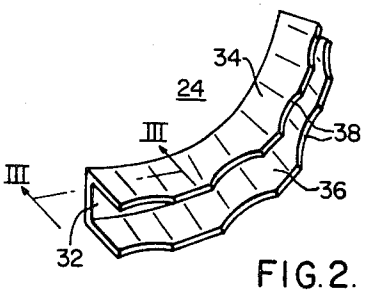


FIG. 2.

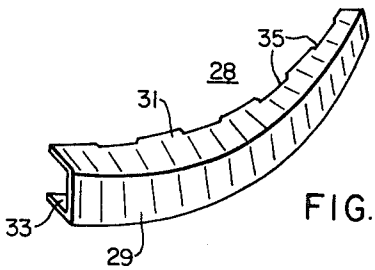


FIG. 2A.

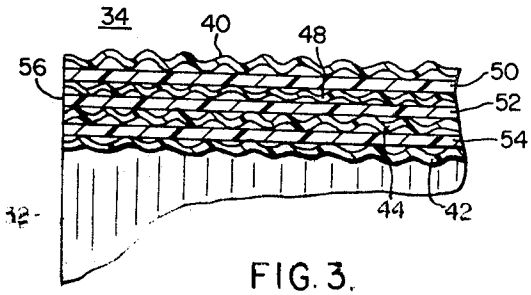


FIG. 3.

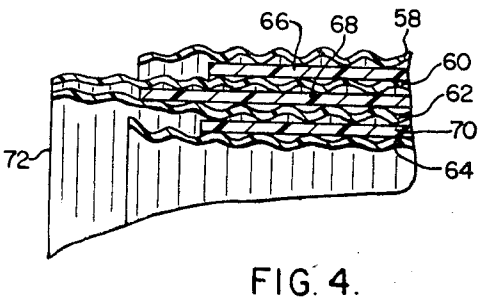


FIG. 4.

INSULATING MEMBER FOR TRANSFORMER COILS

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates, in general, to electrical inductive apparatus and, more specifically, to insulating members for rectangular pancake-type transformer coils.

2. Description of the Prior Art

Large shell-form power transformers contain a plurality of substantially rectangular pancake-type coils. The pancake coils have insulating structures disposed thereon to provide satisfactory spacing between adjacent coils.

A common form of such insulating structures extends around the edges of the coils. These channel or U-shaped members are ordinarily positioned at the inner and outer edges of the coil. They provide mechanical support for the coil turns in addition to electrically insulating them for adjacent coils. The channel members which are positioned along a straight side of the coil are substantially straight. The channel members which are positioned around a corner of the coil are curved to conform to the shape of the coil.

Various methods and materials have been used for constructing channel members. Construction of the corner channel members is especially critical because of the necessity of curving the channel. One arrangement using double-corrugated pressboard for the curved channel is taught by U.S. Pat. No. 3,351,693, which is assigned to the same assignee as this invention. The pressboard is double-corrugated before being bent into shape to prevent folds and wrinkles at the edges. Another arrangement is taught by U.S. Pat. No. 3,189,681, wherein the channel is constructed of a plurality of plies of a stretchable paper sheet material bonded together by a thermoplastic resin. The stretchable paper sheet allows the channel to be bent without causing folds and wrinkles at the edges.

Although the arrangements known in the prior art are useful, they exhibit certain disadvantages. When using stretchable paper, the channel member lacks the desired mechanical strength for large channel members. When substantial mechanical strength is desired, pressboard may be used, however, forming thick pressboard requires special techniques, such as double-corrugating.

Since the straight and curved channel members are normally constructed from separate materials, a joint exists where they abut around the edge of the coil. For mechanical and electrical reasons, it is desirable to maintain the joint gap as small as possible. When channel members are constructed with a butt end, the joint gap is determined mainly by the spacing between the channel members. Since constant spacing is difficult to maintain, the joint gap varies with this type of channel member.

Therefore, it is desirable, and it is an object of this invention, to provide an insulating channel member which may be easily constructed of inexpensive materials while still providing adequate mechanical strength. It is another object of this invention to provide channel members which may be joined without forming a joint gap therebetween.

SUMMARY OF THE INVENTION

There is disclosed herein a new and useful insulating Channel for pancake coils. The channels are formed from a plurality of layers of different materials. One layer comprises a suitable crepe paper material. Another layer comprises a suitable pressboard material. Adhesive, such as a thermoplastic resin, is applied to the layers to bond the layers together. At least one layer of crepe paper separates layers of pressboard from each other, thereby providing a means for the pressboard layers to slip with respect to each other during the channel forming operation. The channel member is inexpensive to construct and has excellent electrical and mechanical properties.

BRIEF DESCRIPTION OF THE DRAWING

Further advantages and uses of this invention will become more apparent when considered in view of the following detailed description and drawing, in which:

FIG. 1 is an elevational view, partly in section, of a transformer constructed with insulating channel members disposed on the transformer coils;

FIG. 2 is a view of an inner corner insulating channel member constructed according to the teachings of an embodiment of this invention;

FIG. 2A is a view of an outer corner insulating channel member constructed according to the teachings of an embodiment of this invention;

FIG. 3 is a sectional view of the channel member shown in FIG. 2 taken along the line III—III; and

FIG. 4 is a sectional view of an end of a channel member constructed according to another embodiment of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Throughout the following description, similar reference characters refer to similar members in all figures of the drawing.

Referring now to the drawing, and FIG. 1 in particular, there is shown a shell-form type power transformer. The transformer includes a casing **10**, a laminated magnetic core **12**, and a winding structure **14**. The magnetic core **12** is supported from the casing **10** by insulating blocks **16**. The winding structure **14** comprises a plurality of axially spaced pancake-type coils, such as the coil **18**. The coil **18** includes a plurality of conductor turns **20** which are spirally disposed in a substantially rectangular shape. The inner edge of the pancake coil **18** is covered with insulating channel members, such as the straight channel **22** and the curved channel **24**. Similarly, the outer edge of the pancake coil **18** is covered with insulating channel members, such as the straight channel **26** and the curved channel **28**. In one embodiment of this invention, the channels butt or overlap each other to form joints, such as the joint **30**.

The channel members are constructed of materials which insulate and hold the coil turns in position. A view of a channel member, such as the inner curved channel **24**, is shown in FIG. 2. The channel **24** includes an axial side **32** which is positioned in the axial direction of the coil **18**. The channel **24** also includes radial sides **34** and **36** which extend outwardly from the axial side **32** in a direction parallel to the radial axis of

the coil **18**. The channel **24** is substantially U-shaped and has a radius of curvature suitable for fitting closely around an inner corner of the coil **18**.

The outward ends of the radial sides **34** and **36** may have notches or scallops **38** therein which help prevent folds and wrinkles in the channel during its forming. The straight channels and the outer curved channels are constructed similar to the channel **24**. The straight channels are not curved at all and the outer curved channels are curved with the axial sides on the outside of the curve. The construction arrangements taught by this invention are equally applicable to inner, outer, straight, and curved channel members.

An outer channel **28** is shown in FIG. 2A. The channel **28** includes an axial side **29** and radial sides **31** and **33**. The channel **28** is substantially U-shaped and has a radius of curvature suitable for fitting closely around an outer corner of the coil **18**. The inner ends of the radial sides **31** and **33** have scallops **35** therein which allow the channel **28** to be bent without the side **31** and **33** wrinkling.

A partial sectional view, taken along the line III—III of FIG. **2**, is shown in FIG. **3**. FIG. **3** illustrates a channel construction arrangement according to one embodiment of this invention. The axial side **34** of the channel member **24** is constructed of a plurality of layers of insulating material. The outside layers **40** and **42** may be any suitable material which stretches sufficiently during the forming process. During the forming process, the flat insulating materials are formed into the U-shape of the channel member. As illustrated in FIG. **3**, stretchable layers **44** and **48** are positioned between the layers **50**, **52** and **54**. The number of layers may be changed without departing from the scope of this invention.

Layers **40**, **42**, **44** and **48** are constructed of a suitable stretchable insulating materials, such as creped high density kraft paper having about 25 crimps per inch. Layers **50**, **52** and **54** are constructed of a suitable substantially rigid insulating material, such as pressboard. The pressboard may be corrugated to facilitate shaping. A suitable adhesive, such as a thermoplastic resin, is applied to the layers to bond the structure together. The layers **50**, **52** and **54** of rigid insulating material give the channel sufficient mechanical strength. The layers **40**, **42**, **44** and **48** give the channel sufficient resistance to folds during the forming process by allowing the pressboard layers to slip with respect to each other. The resulting channel has excellent mechanical strength and rigidity and is easily constructed.

Changing the number of total layers, the number of layers of crepe paper which separate pressboard layers, or the number of pressboard layers, is within the contemplation of this invention. The crepe paper layer, or layers, between the pressboard layers allows the pressboard layers to slide with respect to each other during the forming operation.

The layers **40**, **42**, **44**, **48**, **50**, **52** and **54** are cut to the same length to form a straight end **56** for forming a butt-type joint. An embodiment of this invention for forming scarfed joints is illustrated in FIG. **4**. Layers **58**, **60**, **62** and **64** are constructed to stretchable insulating material, such as crepe paper. Layers **66**, **68** and **70** are constructed of a suitable material, such as pressboard. The ends of the layers form a staggered pattern which makes the end of the channel tapered, that is, the middle layers are larger than the outer layers. Other staggered patterns may be used to scarf the ends of the channel without departing from the spirit of the invention. The pattern is arranged to mate with a scarfed end of an adjacent channel member to form a scarfed joint.

The channel members disclosed herein provide electrical insulating structures with sufficient mechanical strength by utilizing the properties of different materials. Since numerous changes may be made in the above described apparatus and different embodiments of the invention may be made without departing from the spirit thereof, it is intended that all of the matter contained in the foregoing description, or shown the accompanying drawings, shall be interpreted as illustrative rather than limiting.

I claim as my invention:

1. Electrical inductive apparatus having a winding, said winding comprising a plurality of pancake-type substantially rectangular coils, insulating members disposed around the edges of said coils, each of said insulating members having a U-shaped cross-section with an axial side and two radial sides, said axial and radial sides being constructed of a laminated insulating material comprising at least two layers of crepe paper separated by a layer of pressboard with an adhesive material applied to said layers.

2. The electrical inductive apparatus of claim **1** wherein the insulating members having a U-shaped cross-section are curved to conform to the shape of a coil corner.

3. The electrical inductive apparatus of claim **1** wherein the insulating members have first and second ends, said first and seconds ends having a scarfed pattern with the length of the layers varying across the thickness of the insulating material.

4. The electrical inductive apparatus of claim **1** wherein the adhesive material is a thermoplastic resin and the crepe paper has about 25 crimps per inch.

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