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(12) # EUROPEAN PATENT APPLICATION

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(54) **Insulation system for magnetic windings having stacked planar conductors.**

(57) In a magnetic component, the windings comprise planar conductive sheet windings or windings having conducting paths deposited on a flexible substrate such as a polyimide material to form individual truns of a winding. These turns are stacked and conducting paths interconnected to form a magnetic winding which interacts with a magnetic core member of the component. A polyimide material (e.g. Kapton) coverlay is applied to a each turn member to provide appropriate insulation.

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Field of the Invention

This invention relates to magnetic components having windings of planar sheet conductors or having planar conductive paths etched printed or deposited on a planar substrate, and in particular to an insulation system for these windings of the magnetic component.

Background of the Invention

The performance of electrical systems and components is largely dependent on the performance of the electrical insulation of those components and systems. This is particularly true in instances of magnetic components utilizing electrical windings. Factors such as creepage and clearance distances may enhance safety while detracting from the electrical performance of the component. It is therefore desirable to find forms of insulation that provide needed safety performance while also providing optimal electrical performance.

Summary of the Invention

A magnetic component, having an insulation system embodying the principles of the invention, includes windings formed as defined in claim 1.

Brief Description of the Drawing

In the Drawing:

FIG. 1 is an exploded perspective view of a bobbin construction of a magnetic component for supporting planar windings comprising a sheet conductor to which the coverlay insulation system may be applied;

FIGS. 2 and 3 are an elevated and plan view for a magnetic component with a magnetic core and utilizing the bobbin and windings as shown in the FIG. 1;

FIGS. 4 and 5 are an elevated and plan view of the coverlay insulation system as applied to a a flexible substrate containing a conductor attached thereon;

FIG. 6 shows a winding in which a conducting path is mounted on a flexible substrate and to which the coverlay insulation may be applied; and

FIGS. 7 and 8 are and elevated and plan view of the coverlay insulation system as applied to a sheet winding.

Detailed Description

FIGS. 1-3 and 6 are substantially the same as the drawings disclosing a magnetic component structure in the U.S. patent 5,179,365. A winding assembly for a magnetic component as assembled on a bobbin structure is shown in the FIG. 1. A plurality of copper sheet conductors 101 are shown arranged to fit on a supporting bobbin structure 110. The individual copper sheet windings 101 are interconnected with each other by conducting pins 115 included in the bobbin structure. Each copper sheet conductor 101 comprises one turn of a winding and by means of the pins 115 are interconnected with other copper sheet conductors to form a complete winding supported by the bobbin structure 110.

The individual copper sheet conductors 101 are stamped from sheet copper in the form of an annular ring. The sheet conductor includes end terminals 111 and 112 in which holes are included to fit over the conducting pins 115 so that the various conductors may be electrically interconnected to each other to form the windings.

An alternative structure for the individual conductive turns of the winding is shown in the FIG. 6. In this arrangement, a copper conductor 607 is either etched, printed or deposited on both sides of a flexible substrate 602. The conductor on each side is extended to a terminal end 615 to permit contact with the pin holes 603 and 604 which are connected to pins 115 of the bobbin structure of FIG. 1 to interconnect the turns into a winding. The top and bottom conductors affixed to the sbustrate are connected in series with each other by vias 621 and 622

A magnetic component 201 adapted for use with the flex or sheet conductors is shown in both a plan and an elevation view in FIGS. 2 and 3, as being mounted on a circuit substrate 305. This component includes the bobbin 110 and the windings as shown in the FIG. 1. The bobbin 110 includes support members 111 resting on the substrate 305 which supports the component.

The magnetic core 220 is made of a ferrite material and comprises a base structure 218 and a cover structure 219. The core windows 231 and 232 through which the windings pass define a annular or circular path which conform to circular segments of the annular conductors. The windows and conductors are dimensioned so that the stacked winding efficiently fills the window space.

Details of the insulation construction of conductors supported by a flexible substrate are shown in the FIGS. 4 and 5. The insulation system is constructed of a first and second polymeric insulating film members 401, 402 composed of a polymeric material such as a polyimide film which is deposited on opposing sides of a flexible substrate 405 supporting the conductor paths 406 and 407 etched, printed or deposited on both sides of the flexible substrate 405 such as is disclosed in the schematic of FIG. 6. The polyimide insulating films 401 and 402 have a shape conforming to the edges of the substrate and a peripheral extent substantially equaling the peripheral extent of the substrate 405 supporting the conductive material. This insulating film when joined adhesively to forms an insulating coverlay. An adhesive, such as an acrylic adhesive, is applied between the substrate and the polymeric film. Heat and pressure is applied to the assembly by two hot flexible plates that compress the polymeric films against the substrate. The film members under pressure conform to the affixed conductor paths and to the inner and outer edges of the substrate material. These polymer film members are positioned so as to cover the annular portion of the flexible substrate and its conductive material forming the current paths. A terminal end 425 extends beyond the insulated portion to facilitate interconnection to the bobbin pins and hence to other conductors.

The coverlay portions of the polymeric insulating film of each flexible substrate are bonded to the base substrate 405 by the acrylic adhesive to seal the current paths which pass through the annular windows defined by the magnetic core shown in the FIGS. 2 and 3. The substrate and its associated conductor is also insulated from adjacent flexible substrates and their included current paths.

The insulation system as applied to a rigid sheet conductor is shown in the FIGS. 7 and 8. A first and second polymeric organic insulating film 712 and 713 such as a polyimide is deposited on opposing sides of the rigid self supporting conductor 721. It is dimensioned to have a peripheral extent exceeding the peripheral extent of the sheet conductor and overlay the conductors. Adhesive under heat and pressure is applied to the assembly to secure the polymer films to both sides of the sheet conductor and to each other in the overlay region. The film members coverlay the sheet conductor and both the inner and outer peripheral edges of the sheet conductors. The coverlay covers the sheet conductor so that the conductor passing through the annular windows of the magnetics component core is completely insulated from the core and from adjacent sheet conductors.

The overhanging portions of the polymeric insulating film of each rigid self supporting conductor are bonded with an acrylic adhesive under heat and pressure to the conductor and to the opposite insulating film. This forms the insulative coverlay and seals the current paths passing through the annular windows of the magnetic core and from adjacent rigid self supporting sheet conductors containing current paths. Two terminal ends 726 and 727 extend beyond the insulation coverlay to facilitate connection to the bobbin pins and to other conductors.

While the dimension of the polyimide insulating films 401 and 402 in the illustrative embodiment of FIGS. 4 and 5 have a shape and dimension conforming to the edges of the substrate and a peripheral extent substantially equaling the peripheral extent of the substrate 405 supporting the conductive material, it is to be understood that the insulating coverlay may have a peripheral extent exceeding the extent of the substrate 405. This and many other variations may suggest themselves to those skilled in the art within the scope of the invention disclosed herein.

Claims

1. An insulation system for windings of a magnetic component, wherein the magnetic component comprises:

   a core of magnetic material having a central core, peripheral core members and annular windows for accepting windings positioned between the central core and the peripheral core members;

   magnetic windings comprising a plurality of individual annular substrates having a central aperture to fit over the central core and having conductive material operative as current paths affixed on the annular substrates for conducting magnetic excitation currents through the annular windows;

   the magnetic windings mounted onto the core of magnetic material of the magnetic component to fill the annular windows so that the current paths conduct the magnetic excitation currents through the annular windows;

   CHARACTERIZED BY:

   insulation for the magnetic windings comprising:

   first and second polyimide insulating film members deposited on opposing sides of each annular substrate having a peripheral extent exceeding a peripheral extent of the annular substrate and overlaying the substrate periphery and positioned so as to cover the annular substrate and its conductive material forming the current paths passing through the annular windows;

   the overlay portion of the polyimide insulating film of each annular substrate being bonded together with an adhesive to seal the current paths passing through the annular windows from the magnetic core and from adjacent annular substrates having current paths.

2. An insulation system for windings of a magnetic components claimed in claim 1, wherein the magnetic component further comprises:

   the annular substrates have conductive material deposited thereon to serve an individual turn of a winding.

3. An insulation system for windings of a magnetic component claimed in claim 1, wherein the magnetic component further comprises:

   the annular substrates have conductive

material etched thereon to serve an individual turn of a winding.

4. An insulation system for windings of a magnetic components claimed in claim 1, wherein the magnetic component further comprises:
the annular substrate is constructed of a conductive material and serves as an individual turn of a winding.

5. An insulation system for windings of a magnetic components claimed in claim 1, wherein the magnetic component further comprises:
the annular substrates have conductive material printed thereon to serve an individual turn of a winding.

FIG. 1
(PRIOR ART)

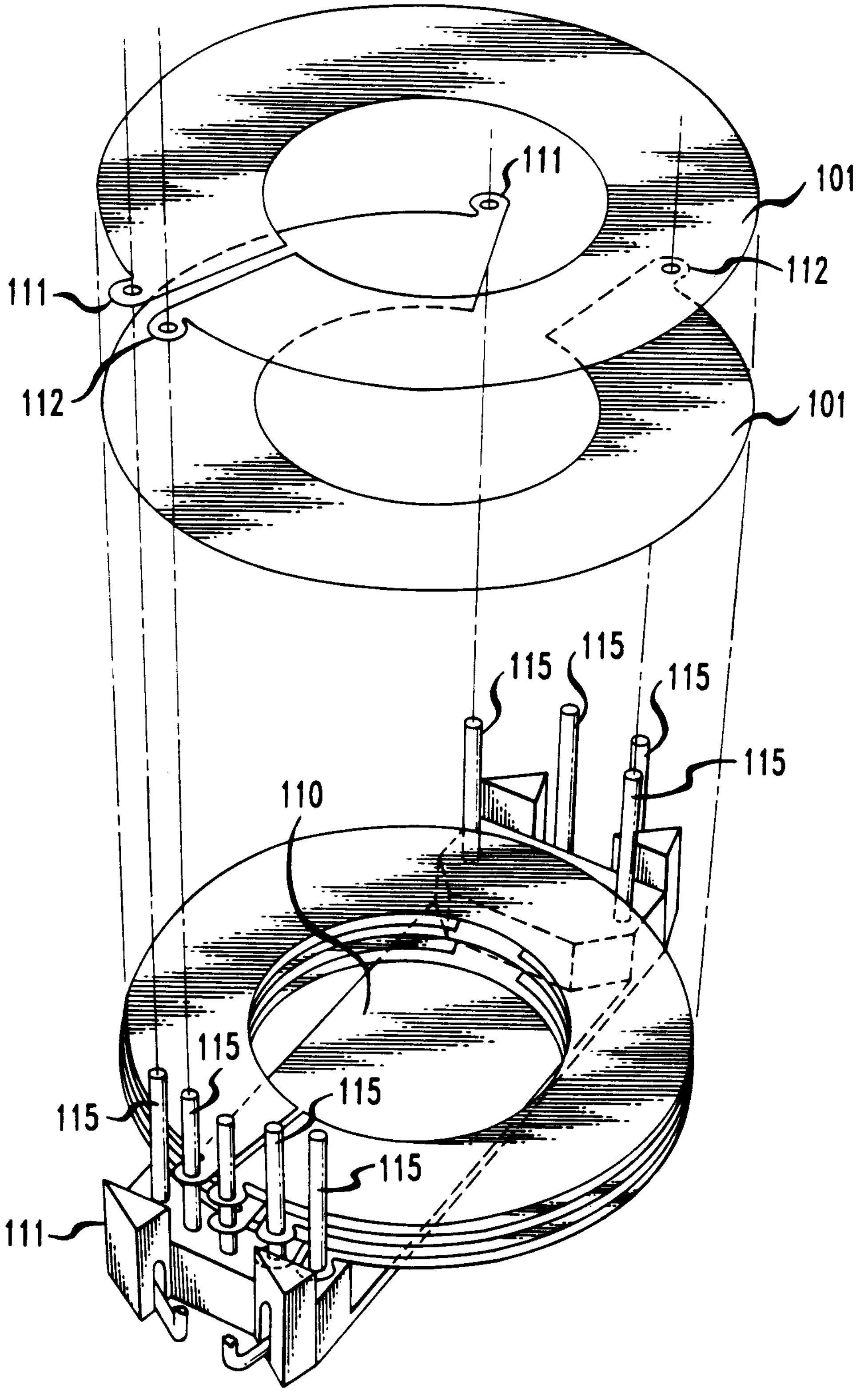


FIG. 2
(PRIOR ART)

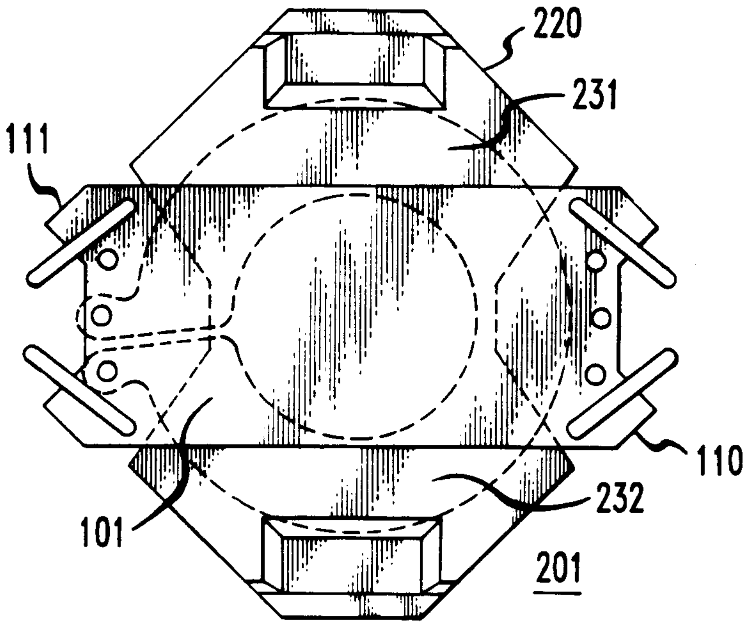


FIG. 3
(PRIOR ART)

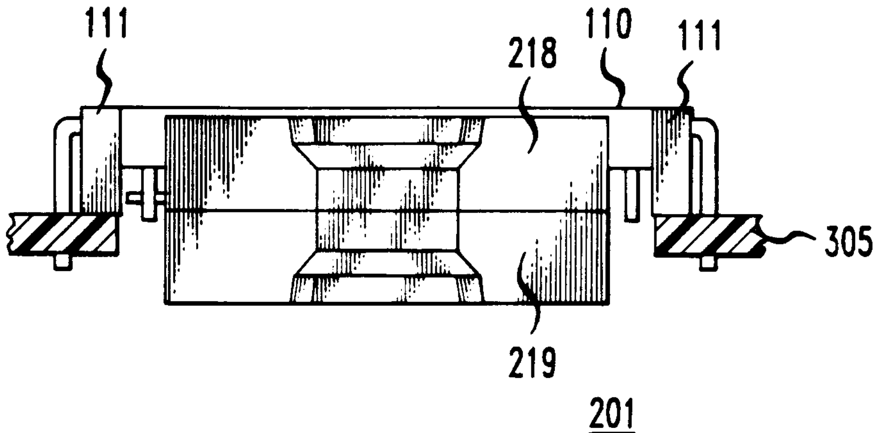


FIG. 4

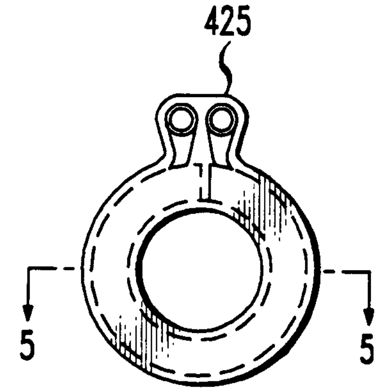


FIG. 5

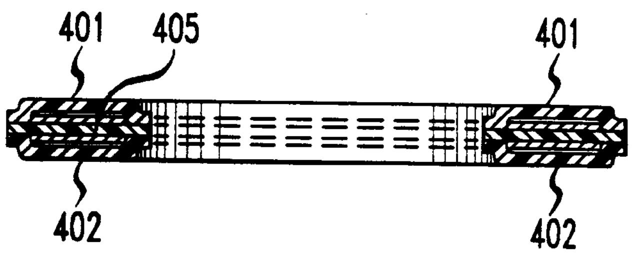


FIG. 7

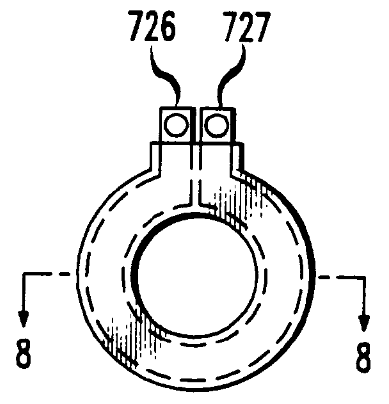


FIG. 8

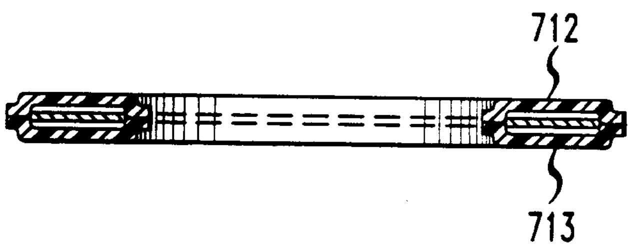
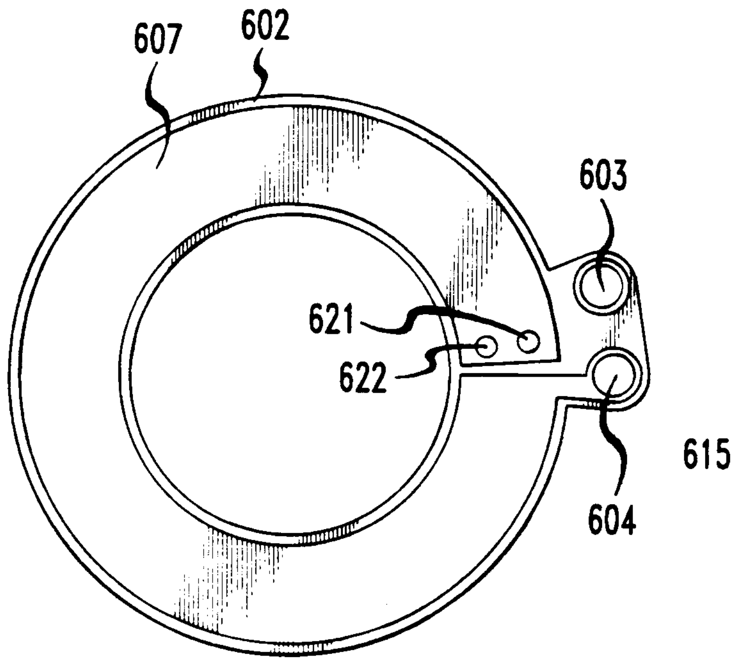


FIG. 6
(PRIOR ART)



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EUROPEAN SEARCH REPORT

Application Number
EP 94 30 0412

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.5)
Y	EP-A-0 522 475 (ABB PATENT) * column 2, line 58 - column 3, line 9 *	1	H01F27/28 H01F41/12 H01F27/32
A	* column 3, line 34 *	3,4	
Y	EP-A-0 310 396 (KABUSHIKI KAISHA TOSHIBA) * column 15, line 21 - line 37 *	1	
A	* column 9, line 65 *	3	
A	WO-A-91 15861 (MULTISOURCE TECHNOLOGY CORPORATION) * page 15, paragraph 2 *	1	
A	* page 1, paragraph 1 *	5	
A	PATENT ABSTRACTS OF JAPAN vol. 11, no. 355 (E-558) (2802) 19 November 1987 & JP-A-62 132 307 (TOSHIBA CORP) * abstract *		
A	PATENT ABSTRACTS OF JAPAN vol. 9, no. 234 (E-344) (1957) 20 September 1985 & JP-A-60 088 411 (FUJI JIKOU) * abstract *		TECHNICAL FIELDS SEARCHED (Int.Cl.5) H01F
A	AT-A-314 646 (SIEMENS)		
A	US-A-3 868 766 (FORD MOTOR COMPANY)		
A	FR-A-2 262 857 (SIEMENS)		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 April 1994	Vanhulle, R

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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