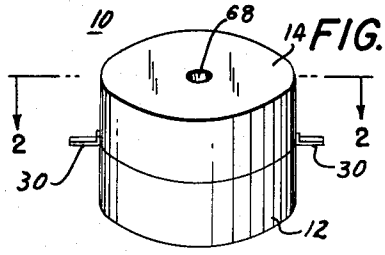
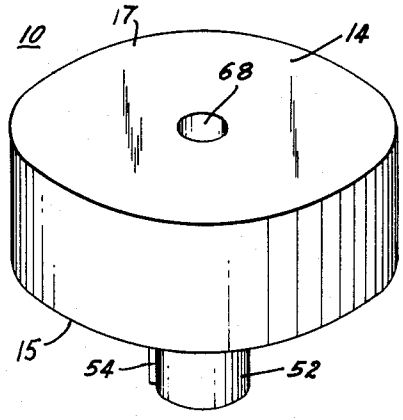
May 31, 1960 B. M. GORDON 2,939,096

ELECTRO-MAGNETIC DEVICE

Filed Nov. 28, 1955

FIG. 1





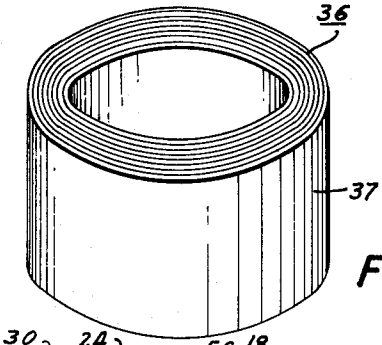


FIG. 4

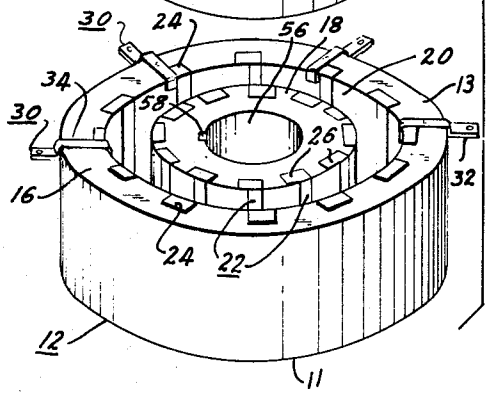


FIG. 2

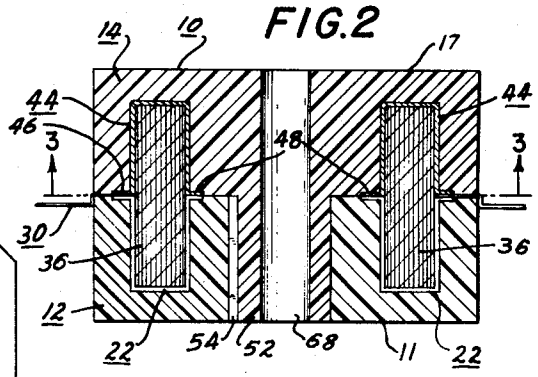
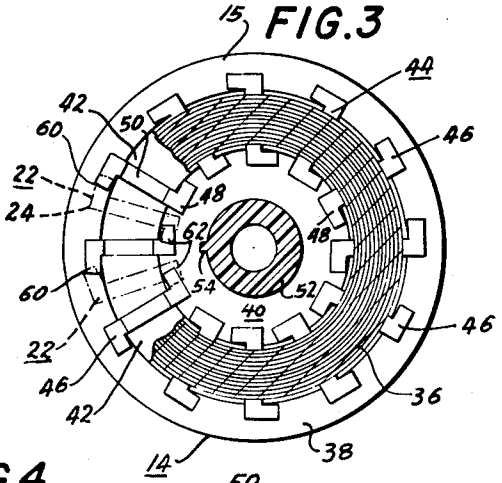


FIG. 3



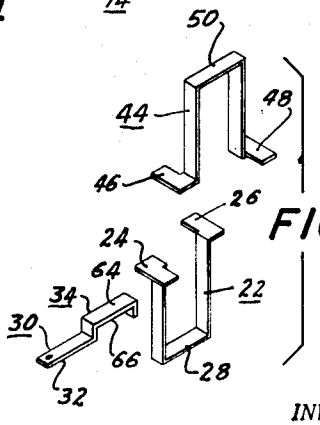


FIG. 5

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ELECTRO-MAGNETIC DEVICE

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1 Claim. (Cl. 336—84)

The invention relates to electro-magnetic devices, and more particularly to electro-magnetic devices used as transformers, transducers, magnetic storage units and other applications.

Heretofore, electro-magnetic devices have been formed by winding a conductor about a core unit, which unit provides a magnetic path. Toroidal type electro-magnetc devices have been provided having a ring core unit providing a closed magnetic circuit of high efficiency. The difficulty of placing a winding about such a ring core unit has greatly increased with a reduction in size of the ring members. This has greatly increased the cost of producing such small units. These units are most useful in conserving space when a great number are utilized as in memory networks. The small size core units also allow higher concentration of flux lines and thereby reduces the current required for energizing the electro-magnetic device.

It is therefore the principal object of this invention to provide a new and improved electro-magnetic device which may be efficiently and inexpensively manufactured.

Another object of the invention is to provide a new and improved electro-magnetic device which does not require winding machinery for its production.

Another object of the invention is to provide a new and improved electro-magnetic device providing an electrical path having numerous turns about its ring core unit.

Another object of the invention is to provide a new and improved electro-magnetic device produced by the ordinary assembling of a plurality of members without winding a conductor around a core unit.

Another object of the invention is to provide a new and improved electro-magnetic device which may be produced using printed circuit techniques.

Another object of the invention is to provide a new and improved electro-magnetic device which may be made especially small and compact.

Another object of the invention is to provide a new and improved electro-magnetic device adapted for readily providing any number of windings and outlet terminals in accordance with design requirements.

Another object of this invention is to provide a new and improved electro-magnetic device which is highly reliable in operation, has a long operating life, and is rugged in construction and not readily damaged.

The above objects are achieved by providing an electro-magnetic device which is toroidal in shape and comprises first and second bodies, each body having marginal and central concentric circular contact surfaces, and an annular core space intermediate the marginal and central contact surfaces. Each of the bodies is provided with a plurality of spaced conductive portions which extend substantially radially from the marginal contact surface to the central contact surface and about the core space.

A ring core unit is received within the core spaces of the bodies. The core unit may be sprayed with an insulating material or otherwise prevented from contacting and shorting out the spaced conductive portions of the bodies.

The first and second bodies are provided with engaging means for securing and aligning them so that the conductive portions of the first body contact respective conductive portions of the second body to provide a helix-like electrical path passing about and progressively along the core unit. Appropriate terminal conductors are provided contacting respective conductive portions of the electro-magnetic device.

By this construction and assembly technique, it is possible to produce a toroidal type electro-magnetic device of extremely small dimensions without the necessity for winding a conductor or conductors about the ring core unit.

The above objects as well as many other objects will become apparent when the following description of the invention is read in conjunction with the drawings, in which:

Figure 1 is a perspective view illustrating an electro-magnetic device embodying the invention,

Figure 2 is an enlarged sectional view taken along the line 2—2 Figure 1.

Figure 3 is a sectional view taken along the line 3—3 of Figure 2.

Figure 4 is an exploded view of the device shown in Figure 1, and

Figure 5 is a detail view in perspective of several conductive elements and a terminal conductor.

Like parts are designated by like numerals throughout the several views.

The electro-magnetic device **10**, comprises a first body **12**, which in many respects is similar to its second body **14**. The body **12** is essentially cylindrical in configuration and may be made of a plastic or other similar insulating material. The bodies **12** and **14** may be formed by machining, pressing or stamping, die-casting or any other suitable method.

The body **12** has an outer end **11** and a contact end **13**. The contact end of the body **12** is provided with a circular contact surface **16** and a central circular contact surface **18**. The contact surfaces **16** and **18** are concentric and separated by an annular concentric recess or groove **20** of substantially rectangular cross-section providing a core space.

The body **12** is provided with a plurality of spaced conductive portions **22** which extend substantially radially from the marginal contact surface **16** to the central contact surface **18** and within the recess **20** about the core space. The conductive portions **22** of the body **12** do not contact each other. The portions **22** may be made by painting or depositing a conductive material at the desired locations or by inserting thin metallic strips or elements **22** shown in Figure 5 with their contact ends **24**, **26** respectively engaging the marginal and central contact surfaces **16** and **18**, while their U-shaped central portions **28** extend within the recess **20** and about the core space.

A plurality of terminal conductors **30**, may be provided for contacting appropriate ends **24** of selected conductive elements **22**. The terminal conductors **30** comprise an extending terminal portion **32**, and a U-shaped securing and contact portion **34** adapted to be received over the ridge formed by the contact surface **16** of the body **12**.

A core unit **36** having desired magnetic properties may be formed by a strip or band of sheet material which is wound to form the cylindrical configuration illustrated. The core unit **36** of course may be made in any other manner such as molding. One end of the core unit **36** is received within the recess **20** of the body **12**. The size of the core unit **36** is such that it minimizes the

inner space within the recess **20** for maximizing the efficiency of the electro-magnetic device **10**. Before the core unit **36** is placed within the recess **20**, the conductive elements **22** within the recess **20** are treated with an insulating material, or the unit **36** is coated with such an insulator on its outer surface **37** to prevent short circuiting of the conductive elements **22** by the core unit **36**.

The second body **14** is substantially similar in construction to the body **12** so that much of the description given in connection with the body **12** will also be applicable to the body **14**.

The body **14** is substantially cylindrical on configuration and has an outer end **17** and a contact end **15** adapted to engage the contact end **13** of the body **12**. The contact end **15** of the body **14** is provided with a marginal contact surface **38** which is circular and concentric with a central circular contact surface **40**. The contact surfaces **38** and **40** have intermediate them an annular circular recess **42** of substantially rectangular cross-section.

A plurality of spaced conductive portions or elements **44** are provided which have contact ends **46** and **48** respectively engaging the marginal and central contact surfaces **38** and **40**, and an intermediate connecting portion **50** of U-shape which is received within the recess **42** passing about the core space of the body **14**.

Sufficient insulation is also provided so that the second end of the core unit **36** may be received within the recess or groove **42** of the body **14** without short circuiting the conductive elements **44**.

The body **14** is provided with a central tubular portion **52** having a key **54**, while the body **12** is provided with a central opening **56** for receiving the tubular portion **52** and a slot **58** for engaging the key **54** of the body **14**. By these means the bodies **12** and **14** may be aligned and secured to each other, as illustrated in Figures 1 and 2. The bodies **12** and **14** may be permanently secured together by applying an appropriate adhesive to the outer surface of the tubular portion **52** of the body **14**. The bodies **12** and **14** may also be enclosed with a potting compound in the usual manner.

When the core unit **36** is placed within the grooves **20** and **42** of the bodies **12** and **14**, and the bodies **12** and **14** are fully engaged, the core unit **36** is entirely enclosed within the electro-magnetic device **10**. Upon full engagement of the bodies **12** and **14**, an electrical path substantially in the form of a helix is provided which passes about the core spaces formed by the grooves **20** and **42** and around the core unit **36** contained therein. The substantially helical conducting path progresses in the direction along the core spaces of the bodies **12** and **14** and core unit **36**.

This electrical conductive path is accomplished by equally spacing the conductive elements **22**, **44** within their bodies **12**, **14** and aligning the bodies **12** and **14** so that the conductive elements **22** are staggered with respect to the conductive elements **44**. Since the ends **24**, **26** of the units **22** extend in opposite directions as do the ends **46**, **48** of the unit **44**, the contact ends **24**, **26** of the conductive elements **22** contact the respective ends **46**, **48** of the units **44** which are stagger spaced on its opposite sides. This is clearly illustrated in Figure 3 wherein the numerals **60** indicate the contacts made by the contact ends **24**, **46** of respective conductive elements **22**, **44**, while connections **62** are made by the ends **26**, **48** of the respective conductive elements **22**, **44**.

The terminal conductors **30** by making contact with the elements **22**, **44**, provide output and input terminals for the device **10**. The elements **30** when made of a non-conductive material also serve to interrupt the helical winding formed by the conductors **22**, **44**. Also by

placing an insulating coating on the surface **64** of the U-shaped contact portion **34** of the terminal conductor **30**, the conductor **30** will connect with an element **22**, while being insulated from its respective conductive element **44**. This has the effect of terminating a winding at its end by insulating it from the remaining turns and bringing the ends out of the electro-magnetic unit **10** for appropriate electrical connection. When appropriate, the surface **66** of the terminal connector **30** may be provided with an insulating coating while the top surface **64** remains conductive. By these means the terminal conductors **30** by appropriate connection and spacing can form various windings about the core unit **36** as may be required in the production of the electro-magnetic device **10**. Connector **30** may be embedded in body **12** so that its surface **64** is level with surface **16**.

The electro-magnetic device **10** is provided with an opening **68** which passes therethrough and may be used for mounting or supporting purposes.

Although the device **10** has been illustrated for use with a core unit **36**, it may be desirable in appropriate instances to use an air core in which case a core unit such as **36** is not placed within the unit **10**. It also may be desirable to use in place of the pre-formed core unit **36** a material which may be of liquid or plastic form and poured or set within the grooves **20** and **42** of the device **10**.

It also may be possible to form the conductive portions of the bodies **12** and **14** by a printing process on a flat surface before the bodies are formed into the final configurations. It will also be apparent that although the bodies **12** and **14** are shown to be substantially similar, bodies of different shapes and configurations may be combined to form the electro-magnetic device.

Although the invention has been illustrated with regard to a single embodiment, it will be apparent to those skilled in the art, that many modifications and variations of the structure may be made without substantially departing from the spirit of the invention.

What is claimed is:

A helical inductor comprising, a first and second similar insulating bodies, each of said bodies having a groove facing the groove of the other, each of said grooves having a plurality of generally U-shaped conducting elements spaced along the length thereof with the plane of each of said elements oriented generally perpendicular to the axis of said groove, each of said U-shaped elements having first and second ends formed with tabs pointing in opposite directions generally parallel to said axis, said insulating bodies arranged in mating relationship with said first and second tabs of each of said U-shaped elements facing and normally in electrical contact with oppositely pointed tabs of axially displaced adjacent ones of said elements in the opposite groove to form said helical inductor, and further comprising a contact element between and in contact with one facing pair of tabs of respective opposed pairs of said U-shaped elements wherein said contact element has an insulated face in contact with one of said pair of facing tabs and an uninsulated face in contact with the other thereof to define an end point of said inductor and provide a terminal for connection to said end point.

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