May 27, 1958 B. M. GOLDSMITH 2,836,805

ELECTRICAL WINDING CONSTRUCTION

Filed Dec. 4, 1956

Fig. 1.

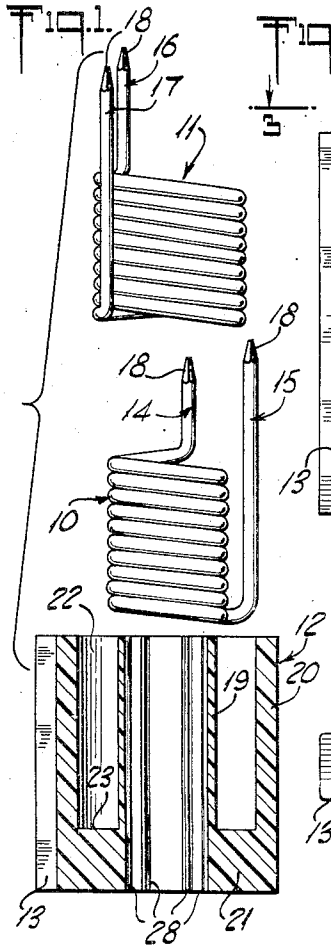



Fig. 2.

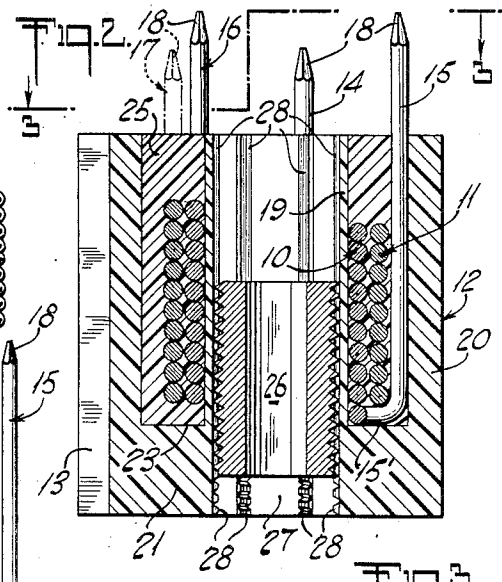



Fig. 4.

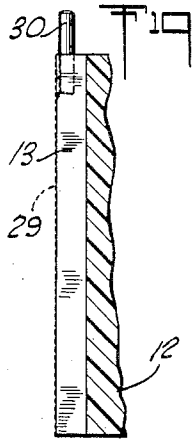



Fig. 3.

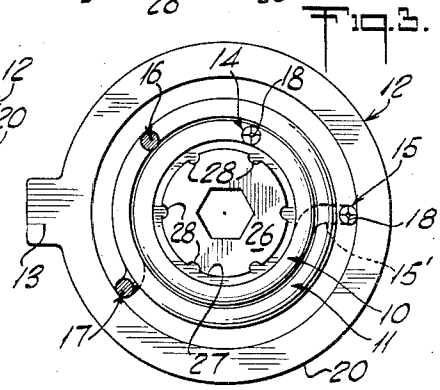



Fig. 5.

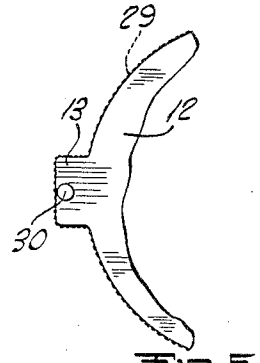



Fig. 6.

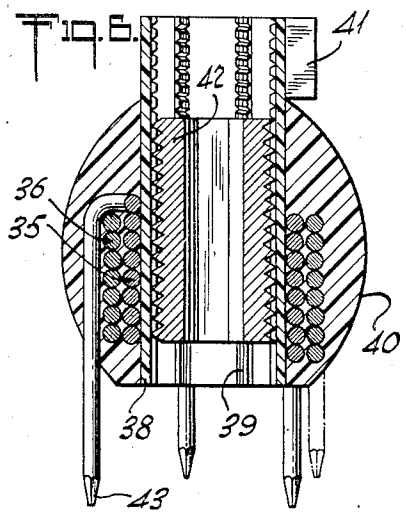
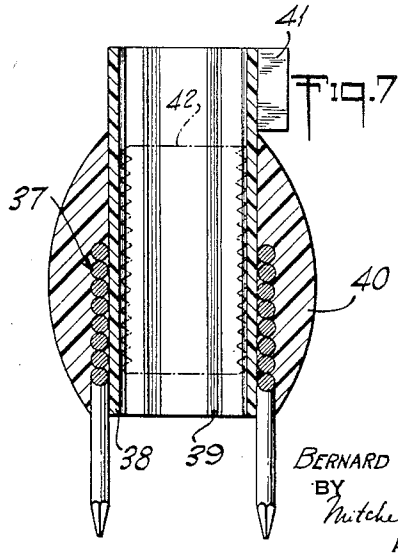



Fig. 7.




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# ELECTRICAL WINDING CONSTRUCTION

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10 Claims. (Cl. 336—136)

My invention relates to an improved electrical coil and transformer construction, rendering the same particularly useful in the automatic assembly of such circuit components into circuit subassemblies, as into printed circuits.

It is an object of the invention to provide an improved construction of the character indicated.

It is another object to provide an improved electrical coil circuit element which can be fabricated at substantially reduced cost.

It is in general an object to meet the above objects with an extremely rugged and simple device which can achieve or exceed the electrical performance of previous structures and which may be so rugged and permanent as to constitute a trouble-free component for the life of the circuit into which it is embodied.

Other objects and various further features of novelty and invention will be pointed out or will occur to those skilled in the art, from a reading of the following specification in conjunction with the accompanying drawings. In said drawings, which show, for illustrative purposes only, preferred forms of the invention:

Fig. 1 is an exploded view of essential components of a transformer construction embodying my invention, and with the body portion shown in longitudinal section;

Fig. 2 is a longitudinal sectional view of the fully assembled transformer of Fig. 1;

Fig. 3 is a top end view of the assembly of Fig. 2, certain of the leads being shown in section, as viewed along the line 3—3 of Fig. 2.

Fig. 4 is a fragmentary longitudinal sectional view illustrating a modification of Fig. 2;

Fig. 5 is a fragmentary top view of the modification of Fig. 4; and

Figs. 6 and 7 are longitudinal sectional views of further embodiments.

Briefly stated, my invention contemplates application to the construction of coils, transformers, chokes, and the like, for use in electronic circuit assemblies as, for example, in the video amplifier of a television set. The invention features integral formation of the turns of the electrical coil with the mounting leads or prongs, and for this purpose, employs relatively heavy, stiff wire for the turns of the coil or coils. The assembly is made rugged and adaptable to receive an adjustably positioned magnetic core by casting the same in a plastic bonding agent, such as an epoxy resin. Various forms will be shown and described.

In Figs. 1, 2 and 3 of the drawings, my invention is shown in application to a transformer construction employing an inner or primary winding **10** and an outer or secondary winding **11**, all contained and solidly embedded in a body **12** which, for convenience in handling, is cylindrical and which, for unambiguous angular orientation, may be formed with an elongated locating rib or key **13** at one angular location. Each of the windings **10—11** is developed from relatively stiff and heavy insulated wire and is shown as a single layer of



turns, the ends of which are so formed and trimmed as to project axially beyond the axial confines of the coils; heavy plastic-coated copper magnet wire or "Copperweld" (copper-sheathed steel) wire provide adequate windings.

The wire from which windings **10—11** are formed is preferably so rugged that the projecting ends **14—15** of coil **10** and the projecting ends **16—17** of coil **11** may serve as the mounting pins for the finished structure, so that no soldering or other connection to separate mounting pins is necessary to integrate the circuit component into its ultimate chassis. For convenience in mounting, the leads **14—15** and **16—17** are preferably nail-pointed, as illustrated at **18**, and, if desired for unambiguous terminal identification, one of the leads for each winding may be caused to project axially further than the other lead for the same winding. Also, if desired (as for unambiguous mounting) and as illustrated in Fig. 3, the respective leads **14—15—16—17** may be oriented within the transformer assembly at non-uniformly spaced intervals.

The body **12** for the transformer may comprise a cup-shaped shell, shown separately in Fig. 1, and preferably formed of suitable plastic, such as molded high temperature nylon, fiberglass, polystyrene, or the like. The body **12** is shown to comprise an inner tubular member **19** and an outer tubular member **20**, connected to each other at **21** at one axial end, so as to define therebetween an annular space **22** for reception of the coils or windings **10—11**. Preferably, the inner winding or primary **10** is wound to a diameter such that it may be concentrically located upon the inner member **19**, and the depth of the opening **22** is such as to receive and axially locate the winding **10** on the bottom surface **23** for unambiguous automatic insertion, in such manner that the leads **14—15** project as desired beyond the open end of the body **12**. The other or secondary winding **11** is preferably formed for concentric location on the primary winding **10** and so that, when bottomed against the lead offset **15'**, its own leads **16—17** will project as desired beyond the open end of the body **12**.

To complete the solid assembly once the windings **10—11** have been inserted, the windings are fully potted within the opening **22**, as by employment of a quick-setting plastic potting compound **25**, such as an epoxy resin.

In order that body **12** may accommodate a magnetic-core element **26**, I prefer that a bore **27** shall extend the full length of the body **12** and that one or more elongated ribs **28** be formed therein at angularly spaced locations. Thus, for the case of a threaded core element **26**, a self-tapping engagement may be had with the ridges **28**. For the arrangement shown in Fig. 2, the core element **26** has been inserted from the bottom and to the extent necessary to determine the desired electrical performance. When thus inserted, the friction, by reason of self-tapped threaded engagement, is found adequate to hold the adjustment throughout the life of the component. It will be noted from the drawing that I have indicated a preference that the coil or coils shall be located substantially axially inwardly of the housing end from which the core member **26** is inserted, the extent of such inward location being of at least substantially the diameter of core member **26**; this relationship assures that core member **26** may be mechanically well supported by the bore **27** for the greatest possible range of adjustment of electrical performance of a given component assembly.

In the arrangement of Figs. 4 and 5, I show that my transformer construction lends itself readily to electrostatic shielding as by merely spraying a metalizing coat, suggested by heavy dashed lines **29**, around the full cylindrical periphery of the body **12**. Ground connections

may be established directly to the shield **29**, but in the form shown, a ground or anchor pin **30** is embedded in the body **12**, as at the key portion **13** thereof, and projects axially beyond the mounting end of the assembly. If desired, the pin **30** may be embedded relatively close to the outer limit of key **13**, as best shown in Fig. 5, so that by merely scraping away a local portion of the plastic of body **12** alongside pin **30**, and prior to spraying the coat **29**, it is possible to spray the coat **29** in good permanent electrical contact with the ground pin **30**, thus obviating any need to establish a further electrical connection between these parts. It will be noted that when a mounting pin **30**, or for that matter, when a key **13** is employed, there is provided an unambiguous means for orienting the complete transformer assembly, so that (at least for mounting purposes) there is no particular need that the leads **14—15—16—17** shall be of different lengths beyond the end of the transformer body, or that they be at differently spaced angular locations.

In the arrangements of Figs. 6 and 7, I show applications of my invention to a less expensive construction involving many of the same principles. The arrangement of Fig. 6 differs essentially from that of Fig. 7 in that Fig. 6 shows a transformer having windings **35—36**, whereas Fig. 7 shows but a single coil **37**, which may be a choke coil. In each case, the winding or windings are supported on an inner tubular member **38** which may be of high-temperature nylon, fiberglass or polystyrene, or the like, and which is preferably formed with elongated inner ribs **39**, as described at **28** for the case of Fig. 2. Plastic bonding is achieved by merely dripping a quick-setting plastic, such as an epoxy resin **40**, over the winding or windings and overlapping the same onto the tubular core **38**. If desired, a locating lug or key **41** may be formed with the tubular core or support **38** and a magnetic-core element **42** inserted, as discussed at **26** in connection with Fig. 2. The leads for the various windings of Figs. 6 and 7 again are preferably formed integral with the turns of their respective coils and project axially in the same direction beyond the body of the assembly, the ends of the leads being nail-pointed as at **43**, to permit non-fouling insertion in a suitable socket, not shown.

It will be appreciated that I have described an improved coil and transformer construction featuring extreme ruggedness and reduced cost of manufacture. My constructions are adaptable to completely automatic manufacture and, once having been manufactured, they are adaptable to fully automatic assembly into an ultimate chassis, as, for example, into a printed circuit, the key **13** or **41** (or the unambiguously located lead ends or prongs) being such as to facilitate automatic handling for automatic assembly. My transformers are found to exhibit a clearly predictable frequency-drift coefficient (as a function of temperature) which lends itself to the controlled determination of shift coefficient, as by employing at **25** or **40** a bonding or potting agent so constituted as to develop in the completed assembly a particular desired positive, negative or neutral drift characteristic.

While I have described the invention in detail for the preferred forms illustrated, it will be understood that modifications may be made within the scope of the invention as defined in the claims which follow.

I claim:

1. In combination, a plastic tubular coil-supporting body member having inner and outer surfaces, and an electrical winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the outer surface of said body member, one end of said winding being straight and integrally formed to project axially beyond the corresponding axial end of said body member, the other end of said winding being straight and integrally formed to run adjacent the radially outer side of said winding and to project axially beyond the said axial end of said body member at a location angularly spaced from said first projecting end, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, and means permanently bonding said winding to said body member and said other straight end of said winding to said radially outer side of said winding.

2. In combination, a plastic tubular transformer body member having inner and outer surfaces, a first winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the outer surface of said body member, a second winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the turns of said first winding, first corresponding ends of the wires for said first and second windings being straight and integrally formed to project axially beyond one axial end of said body member at angularly spaced locations, the other corresponding ends of the wires for said first and second windings being straight and integrally formed to run adjacent the radially outer side of said second winding and to project axially beyond said axial end of said body member at angularly spaced locations which are spaced from said first-mentioned angularly spaced locations, the weight and stiffness of said wires being such that said combination may be fully oriented and supported directly and solely by the projecting ends thereof, and means bonding said windings to each other and to said one wall of said body member and bonding said straight other corresponding ends to said radially outer side of said second winding.

3. In an electrical-coil assembly, a coil of relatively stiff wire with the ends of said coil projecting integrally and axially to serve as direct plug-type lead-in connections, a tubular plastic core engaging the radially inner side of said coil, whereby said coil may be initially located on said core, one of said wire ends being straight from one end of said coil and projecting axially beyond the corresponding axial end of said plastic core, the other of said wire ends being formed to run adjacent the radially outer side of said coil and to project straight beyond said axial end of said core in angularly spaced relation with said one wire end, whereby said projecting wire ends define lead-in connections, and a plastic bonding material bonding said other wire end to said coil and said coil to said plastic core, the size and stiffness of said wire being sufficient in relation to the weight of said assembly for said lead-in connections to provide the substantial mounting support for said coil assembly.

4. In combination, a plastic body member comprising concentric inner and outer tubular portions connected at one axial end and defining therebetween an annular space open at the other axial end, a first winding of relatively stiff wire supported within said space and substantially on the outer surface of the inner tubular portion of said body, a second winding of relatively stiff wire axially overlapping and supported by said first winding, the separate ends of both windings projecting to define integral plug-type leads at different angular locations axially beyond the open end of said body, the axially inner wire ends of said respective coils being integrally formed to run adjacent the radially outer side of said second winding, and plastic bonding material bonding adjacent parts of said inner wire ends to said second winding and bonding the turns of said windings to each other and to said inner tubular portion, the stiffness of said wire being such in relation to the weight of said combination that said integral plug-type leads provide the substantial mounting support for said combination.

5. In combination, a generally cup-shaped container including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, a coil of heavy insulated wire in radially located relation with the inner one of said

walls, and a potting of plastic material solidly filling that part of the said annular space in which said coil is located, the ends of said wire projecting freely and axially beyond the confines of said potting at the same axial end of said container, the wire end at the axially inner end of said coil being formed radially outwardly offset and running straight alongside the outer side of said coil and within said outer wall, and the weight and stiffness of said wire being such in relation to the weight of said combination that said projecting wire ends may provide the substantial support of said combination.

6. In combination, a generally cup-shaped container including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, a first coil of heavy insulated wire having turns in radially located relation with the inner one of said walls, a second coil of heavy insulated wire surrounding and in radially located relation with the turns of said first coil, and a potting of plastic material solidly filling that part of said annular space in which said coils are located, the ends of the wires of said coils projecting freely and axially beyond the confines of said potting and beyond the same axial end of said container, the wire ends at the axially inner ends of said coils being formed radially outwardly offset at angularly spaced locations and straight alongside the outer side of said second coil and within said outer wall, and the stiffness of said wires being such in relation to the weight of said combination that said projecting wire ends provide the substantial support of said combination.

7. In combination, a generally cup-shaped container including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, a coil of heavy insulated wire in radially located relation with the inner one of said walls, and a potting of plastic material solidly filling that part of the said annular space in which said coil is located, the ends of said wire projecting freely and axially beyond the confines of said potting at one axial end of said container, the wire end at the axially inner end of said coil being formed radially outwardly offset and straight alongside the outer side of said coil and within said outer wall, the weight and stiffness of said wire being such in relation to the weight of said combination that said projecting wire ends may provide the substantial support of said combination, and a threaded ferromagnetic core member adjustably positionable in the bore of said tubular member, said coil being axially spaced from one end of said tubular member by an amount at least substantially equivalent to the bore diameter of said tubular member.

8. In combination, a generally cup-shaped container including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, a first coil of heavy insulated wire in radially located relation with the inner one of said walls, a second coil of heavy insulated wire surrounding and in radially located relation with the turns of said first coil, and a potting of plastic material solidly filling that part of said annular space in which said coils are located, the ends of the wires of said coils projecting freely and axially beyond the confines of said potting at one axial end of said container, the wire ends at the axially inner ends of said coils being formed radially outwardly offset at angularly spaced locations and straight alongside the outer side of said second coil and within said outer wall, and the stiffness of said wires being such in relation to the weight of said combination that said projecting wire ends provide the substantial support of said combination, and a threaded ferromagnetic core member adjustably positionable in the bore of said tubular member, that coil which is axially nearest one end of said tubular member being spaced from said one end by an amount at least substantially equivalent to the bore diameter of said tubular member.

9. In combination, a generally cup-shaped container open at one end and including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, and an electrical winding having a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the outer surface of said inner wall, one end of said winding being straight and integrally formed to project axially beyond the open end of said container, the other end of said winding being straight and integrally formed to run adjacent the radially outer side of said winding and to project axially beyond said open end of said container at a location angularly spaced from said first projecting end, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, and plastic means substantially closing the open end of said container and holding the straight projecting ends of said wire in angularly-spaced relation.

10. In combination, a generally cup-shaped container open at one end and including an upstanding inner tubular member of electrically insulating material defining an annular space between inner and outer walls, a first electrical winding having a single layer of turns of relatively heavy and stiff insulated wire deriving concentric support directly from the outer surface of said inner wall, one end of said first winding being straight and integrally formed to project axially beyond the open end of said container, a second electrical winding having a single layer of turns of relatively heavy and stiff insulated wire deriving concentric support directly from the turns of said first winding, the axially inner ends of both windings being straight and radially offset and running alongside the outer limit of said second winding and projecting axially beyond the open end of said container, the other end of said second winding being straight and integrally formed to project axially beyond the open end of said container, and plastic means substantially closing the open end of said container and holding the straight projecting ends of both said wires in angularly-spaced relation.

**References Cited** in the file of this patent

UNITED STATES PATENTS

| | | |
|---|---|---|
| 1,489,370 | Steinberger | Apr. 8, 1924 |
| 1,533,749 | Meirowsky | Apr. 14, 1925 |
| 1,661,953 | McIntosh | Mar. 6, 1928 |
| 1,763,115 | Wermine | June 10, 1930 |
| 2,404,404 | Roberds | July 23, 1946 |
| 2,553,339 | Silvey | May 15, 1951 |
| 2,695,856 | Firth | Nov. 30, 1954 |
| 2,715,094 | Szekely | Aug. 9, 1955 |
| 2,781,438 | Griffith | Feb. 12, 1957 |

FOREIGN PATENTS

| | | |
|---|---|---|
| 647,072 | France | Nov. 20, 1928 |
| 1,115,231 | France | Apr. 20, 1956 |