March 6, 1962 B. M. GOLDSMITH 3,024,433

ELECTRICAL WINDING CONSTRUCTION

Filed Feb. 14, 1958

Fig. 2.

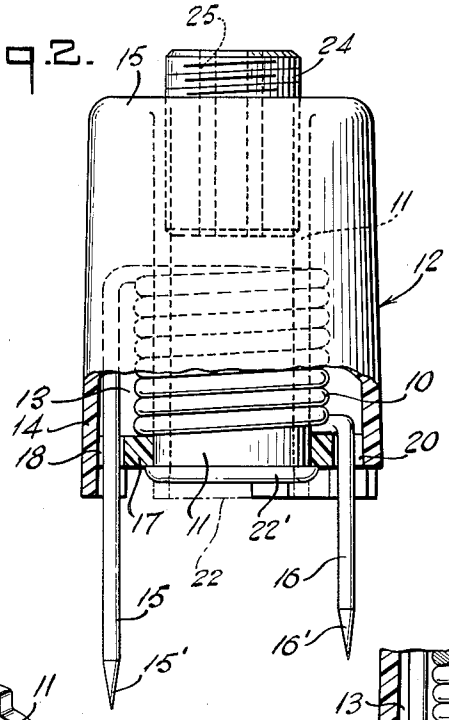


Fig. 1.

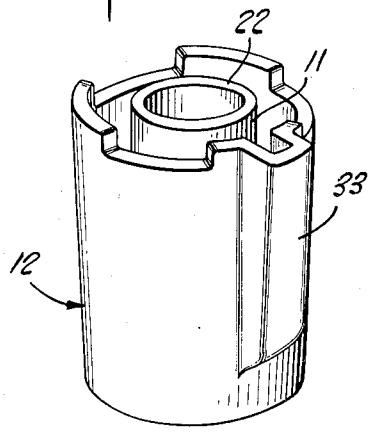
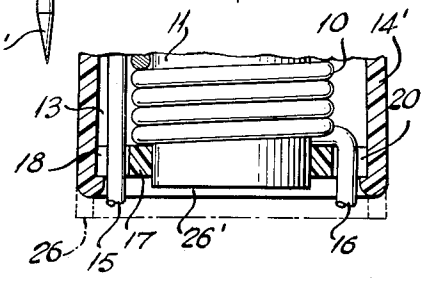


Fig. 4.



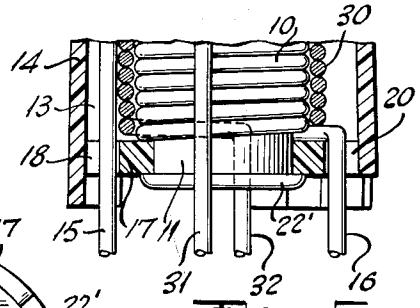
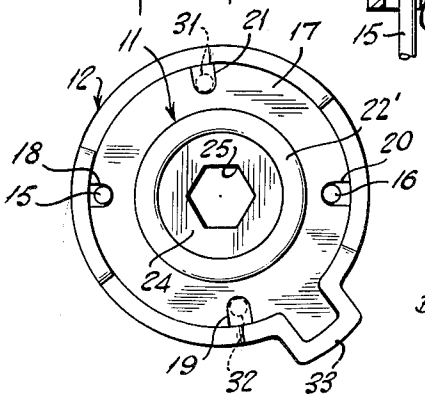


Fig. 5.

Fig. 3.



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ELECTRICAL WINDING CONSTRUCTION

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12 Claims. (Cl. 336—92)

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 circuits, as into printed circuits. This application discloses improvements over and modifications of various forms disclosed in my copending application Serial No. 626,175, filed December 4, 1956, now Patent No. 2,836,805.

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 a specific object to achieve the above objects with a construction in which the ends of the wire of the coil or coils are themselves the mounting prongs, of strength adequate to provide the substantial mounting support for the circuit element.

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 in 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 a view in perspective of a coil or transformer housing embodying features of the invention;

FIG. 2 is a side-elevation view showing a completely assembled coil construction of the invention, the lower portion of the assembly being broken-away to reveal parts in longitudinal section;

FIG. 3 is a bottom-end view of the construction of FIG. 2;

FIG. 4 is a fragmentary longitudinal sectional view illustrating a modification; and

FIG. 5 is a view similar to FIG. 4 to illustrate a further modification.

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 an 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 securing the same in a cup-shaped plastic housing, closure being completed by a cap, as by permanent deformation of plastic parts into permanent mutually locating relation. Various forms will be shown and described.

In FIGS. 1, 2 and 3 of the drawings, my invention is shown in application to a coil assembly in which the coil **10** is received on and concentrically supported by a tubular coil-form portion or stem **11** of a plastic body member **12**. The body member is generally cup-shaped to define an annular space **13** within which the coil **10** is received. Thus, the space **13** is defined by the inner wall or tubular portion **11** and by an outer wall or tubular portion **14**, joined at the upper end, as at **15**, to define the closed end of the housing **12**. The winding **10** may be supported by the inner surface of the outer tubular portion **14**, as disclosed in greater detail in my copending application, Serial No. 688,531, filed October 7, 1957, but I prefer that the winding **10** be developed in close concentrically located relation with the central tubular support or inner tubular portion **11**, as shown.

The winding **10** is developed from relatively heavy and stiff 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 coil and out the open end of the housing. Heavy plastic-coated copper magnet wire or "Copperweld" (copper-sheathed steel wire) is well adapted to form the winding means **10**. The wire from which the winding **10** is formed is preferably so rugged that the projecting ends **15—16** of the coil **10** 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 **15—16** may be nail-pointed by employing conventional machinery, but I indicate my preference that the projecting ends **15—16** shall be merely dipped in a pool of solder and slowly raised so as to develop pointed soldered ends **15'—16'** in the manner of a stalactite, the solder being further desirable for ultimate simpler permanent assembly into a printed circuit. The leads **15—16** may project for different axial lengths (as shown), thereby providing unambiguous terminal identification.

Before assembling the coil **10** to the housing **12**, I prefer to prefabricate the coil **10** with an internal diameter which is slighly less than the outer diameter of the tubular support **11** onto which it is to be ultimately assembled. This assures tight, resilient adherence of the assembled coil **10** on the tubular support **11**, due to the inherent resiliency of the heavy stiff wire from which the winding **10** is developed.

In accordance with the invention, I provide separate closure means in the form of a cover **17**, which in the form shown, is of annular shape designed to fit within the open end of the housing **12** and to close off the space **13** at the open end. The cover **17** may have a control opening for reception and radial location on the tubular support or stem **11** and, as indicated in the drawings, I prefer that the outer tubular portion **14** shall be of generally frustoconical or tapered shape, so that a press-fit within the outwardly flared open end of the tubular portion **14** is involved when assembling the parts into the relation shown in FIG. 2. Preferably, the winding **10** is immediately adjacent the cover **17** upon such assembly. Also, the fit of cover **17** within the tubular portion **14** is preferably such that the skirt of portion **14** projects slightly beyond cover **17**, the skirt being castellated as shown, to permit drainage when processing after assembly into a printed circuit.

As indicated in FIG. 3, the cover **17** is formed with a plurality of angularly spaced openings or recesses **18—19—20—21**, and for the case of a single coil **10**, as shown in FIGS. 2 and 3, only two openings **18—20** need be utilized to locate the straight projecting ends **15—16** of the coil.

When the cover **17** is assembled over the central tubular support or stem **11**, a part **22** of the stem **11** projects axially beyond the cover **17**. In FIG. 1, this projecting part **22** is shown in its initial undeformed state, so as to allow free reception of the cover **17**. However, upon assembly, this projecting end **17** is permanently radially outwardly deformed as by spinning over into the beaded shape shown at **22'** in FIGS. 2 and 3, thus per-

manently axially locating and retaining the cover **17** in place. It will be recalled that the winding **10** is tightly and permanently resiliently held to the stem **11** by virtue of the preferred diameter relationships, so that once the cover **17** is bonded in place by the permanent deformation **22'**, the assembly is complete.

For certain purposes, it is desired to provide means for adjusting the inductance of the coil assembly. In such cases, I prefer that the total axial length of the winding **11** shall be substantially less than the total axial length of the coil-receiving space **13**. This means that if the winding **10** is developed immediately adjacent the cover **17**, there is a substantially elongated space near the closed end of the housing within which substantially no coupling to the winding **10** is achievable. This space affords a convenient support for an adjustable member **24** of magnetic flux-conducting material, such as the threaded plug of ferrite shown. The plug **24** may be rendered adjustable by provision of a central wrench-socket opening **25**, and as will be seen from FIG. 2, substantial support may be provided for the threads of plug **24** (within the inner tubular portion **11**, and sufficiently axially removed from the coil **10**) to afford a maximum range of adjustably coupled relation to coil **10**.

The arrangement of FIG. 4 illustrates an alternative in which the cover **17** is permanently retained by radially inward deformation of a part of the outer tubular member **14'** of the cup-shaped housing. Thus, upon initial assembly of the closure member or cover **17** to the housing, the press-fit of the closure member **17** within the flared open end of the outer tubular portion **14'** is such as to leave a part **26** projecting axially beyond the closure member **17**. Subsequently, this part **26** may be fully or partly radially inwardly deformed into permanent axial-locating relation with the cover **17**, as shown. I indicate my preference for spinning the assembly in order to achieve the bead-type retainer, shown in FIG. 4 at **26'**.

The arrangement of FIG. 5 merely illustrates that both of the constructions shown further lend themselves to reception of an additional winding so as to achieve a transformer construction. Such transformers are disclosed in greater detail in my said copending patent applications, and it merely suffices for the present to indicate that the second transformer winding **30** may also be a single-layer development of turns of relatively heavy and stiff wire of the same type as that used for the winding **10**. The second winding **30** may derive concentric support from the winding **10**, and as previously noted, the coils **10—30** are preferably of substantially lesser axial extent than the space **13** so that plug member **24** may provide a maximum range of coupled adjustment. The leads **31—32** for the second winding may project straight and axially out through further openings **19—21** in the cover, as suggested at **31'—32'** in FIG. 3. It will be noted that both the axially inner lead **15** (for the inner winding **10**) and the axially inner lead **31** (for the outer winding **30**) run straight and adjacent the outer surface of the outer winding **30**.

It will be seen that I have described an improved transformer construction which may be completely rugged and lend itself to fabrication at substantially reduced cost. Fully automatic assembly is possible not only for the circuit component itself, but also for adding the circuit component into a given circuit sub-assembly, as into a printed circuit, in which event, the key formation **33** on the outside of the housing **12** provides a ready means of reference orientation. In all cases, the lead wires are adequate to support the entire structure, even for automatic circuit-assembly handling, and yet they are integral with the turns of the coil or coils.

While I have described the invention in detail for the preferred forms shown, 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 cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having two angularly-spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said closure member at said openings and axially beyond said other end of said housing, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination.

2. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, a first electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from the inner one of said tubular portions, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having two angularly spaced lead-locating openings therein, the ends of said winding being angularly spaced and integrally formed to project through separate of said openings in said closure member and to further project axially beyond said other end of said housing, the weight and stiffness of said wires being such that said projecting wire ends provide the substantial mounting support for said combination.

3. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, an electrical winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, a second electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from said first winding, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having four angularly spaced lead-locating openings therein, the ends of said windings being straight and integrally formed to project through said closure member at said openings and axially beyond said other end of said housing, the weight and stiffness of said wires being such that said projecting wire ends provide the substantial mounting support for said combination.

4. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, a first electrical winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the inner one of said tubular portions, a second electrical winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the outer side of said first winding, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having four angularly spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said closure member at said openings and axially beyond said other end of said housing, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination.

5. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, an electrical winding comprising a plurality of turns of

relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, and a closure member of electrically insulating material having a central opening receiving the inner one of said tubular portions and located thereon and closing off the open end of said space, said closure member being centered within said space to such an extent that a portion of said inner tubular portion extends axially beyond said closure member, said axially projecting part of said inner tubular portion being radially outwardly deformed into permanent axially retaining relation with said closure member, said closure member having a plurality of angularly spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said opening and axially beyond the other end of said housing, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination.

6. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, and a closure member of electrically insulating material received within and tightly fitted to said outer tubular portion to such an axial extent that a part of said outer tubular portion extends axially outwardly from said closure member, said outwardly extending part being permanently radially inwardly deformed into permanent axially retaining relation with said closure member, said closure member having two angularly spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said closure member at said openings and axially beyond the other end of said housing, the weight and stiffness of said wire being such that said projecting wire ends provide substantial mounting support for said combination.

7. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, the outer of said tubular portions being generally frustoconical and flaring outwardly in the direction of said open ends, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, and a closure member of electrically insulating material having an outside diameter and fitting tightly within the flared open end of said outer tubular portion and closing off the open end of said space, said closure member having two angularly spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said closure member at said openings and axially beyond the other end of said housing, the weight and stiffness of said wire being such that the projecting wire ends provide the substantial mounting support for said combination.

8. The combination of claim 7, in which said closure member has a central opening therein to receive the inner of said tubular portions, said inner tubular portion projecting axially beyond said closure member, and said inner tubular portion being radially outwardly deformed into permanent axially locating relation with said closure member.

9. The combination of claim 7, in which the location of said closure member within the flared open end of said outer tubular portion is such that a part of said outer tubular portion projects axially beyond said closure member, said outwardly projecting part being radially inwardly deformed into permanent axially locating relation with said closure member.

10. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having two angularly spaced lead-locating openings therein, the ends of said winding being straight and integrally formed to project through said closure member at said openings and axially beyond said other end of said housing, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, the axial extent of said electrical winding being substantially less than the axial extent of said annular space, and said winding being secured in adjacency to said closure member, whereby an elongated part of said inner tubular portion is free of said winding and is located at the closed end of said housing, and a member of magnetic flux-conducting material adjustably received in said inner tubular support at the closed end of said housing.

11. In combination, a plastic cup-shaped housing comprising inner and outer tubular portions joined at one end to define an annular space open to the other end, a first electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from one of said tubular portions, a second electrical winding comprising a plurality of turns of relatively heavy stiff wire deriving concentric support directly from said first winding, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having four angularly spaced lead-locating openings therein, the ends of each of said windings being angularly spaced and integrally formed to project through separate of said openings in said closure member and to further project axially beyond said other end of said housing, the weight and stiffness of said wires being such that said projecting wire ends provide the substantial mounting support for said combination, the axial extent of said electrical windings being substantially less than the axial extent of said annular space, and said windings being secured in adjacency to said closure member, whereby an elongated part of said inner tubular portion is free of said winding and is located at the closed end of said housing, and a member of magnetic flux-conducting material adjustably received in said inner tubular support at the closed end of said housing.

12. A closed container for an electrical winding to be supported within said container and formed of relatively heavy and stiff wire with the ends thereof projecting in straight parallel spaced relation, comprising a plastic cup-shaped housing including inner and outer tubular portions joined at one end to define an annular space open to the other end, the walls of said space being capacitated to receive and support the winding with the ends thereof projecting straight out said open end, and a closure member of electrically insulating material tightly fitted to one of said portions and closing off the open end of said space, said closure member having two angularly-spaced wire-locating openings therein for receiving and locating the respective ends of the winding.

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