June 14, 1960 W. T. SUTTON, JR 2,941,172

ELECTRICAL WINDING CONSTRUCTION

Filed Sept. 24, 1957

Fig. 1.

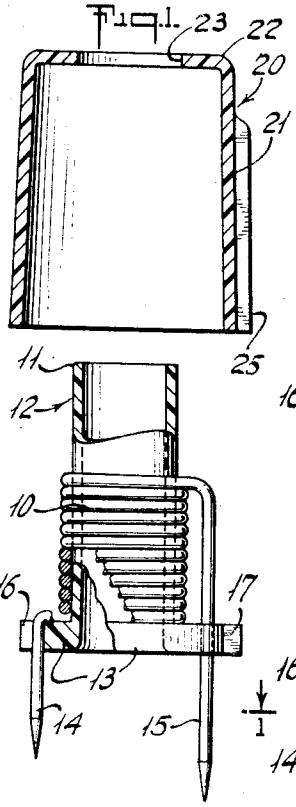
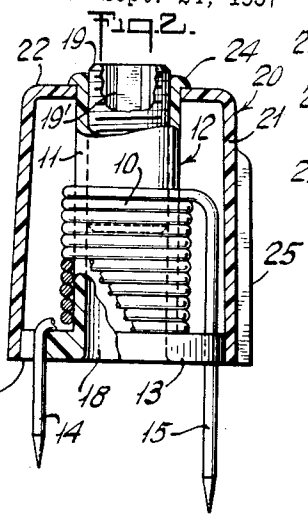


Fig. 2.



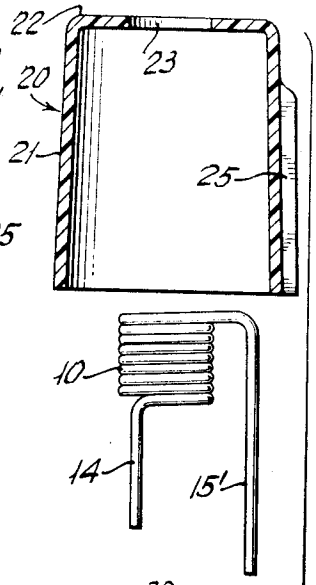
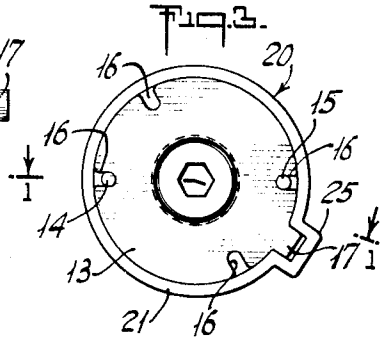


Fig. 3.



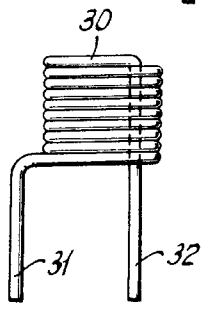


Fig. 5.

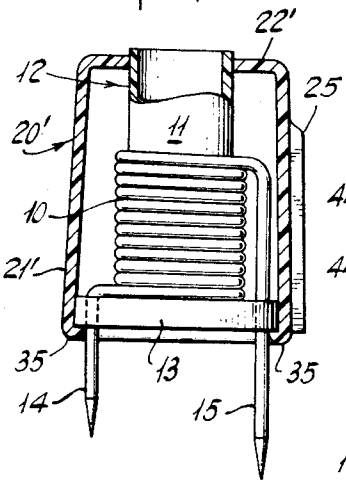
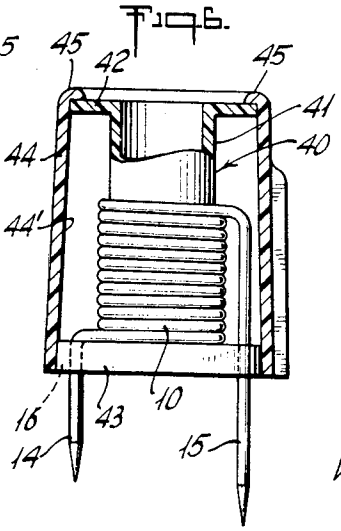


Fig. 6.



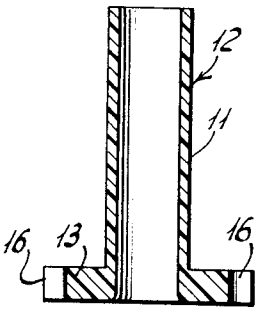


Fig. 4.

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ELECTRICAL WINDING CONSTRUCTION

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11 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 circuit sub-assemblies, as into printed circuits. This application discloses improvements over and modifications of the various forms disclosed in copending Goldsmith application, Serial No. 626,175, filed December 4, 1956.

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 an exploded view of essential components of a coil construction embodying my invention, and with the body portion shown partially in longitudinal section;

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

Fig. 3 is a bottom-end view of the assembly of Fig. 2, showing the section 1—1 for Figs. 1 and 2;

Fig. 4 is an exploded view similar to Fig. 1 but illustrating a component of a transformer construction embodying the same principles; and

Figs. 5 and 6 are views similar to Fig. 2, but illustrating modifications.

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 securing the same with 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 coil assembly in which the coil **10** is developed on or received upon and concentrically supported by a tubular coil-form portion or stem **11** of

a plastic body member **12**. The body member **12** includes at one end thereof an integral radially outwardly extending flange **13** which is shown to serve as an axially locating support for the adjacent end of the coil **10**. 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 so as to similarly project axially beyond the flange **13** when assembled thereto. 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 **14—15** of the coil **10** 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** may be nail-pointed by employing conventional machinery, but I indicate my preference that the projecting ends **14—15** shall be merely dipped in a pool of solder and slowly raised so as to develop pointed solder ends **14'—15'**, in the manner of a stalactite, the solder being further desirable for ultimate simpler permanent assembly into a printed circuit. The leads **14—15** may project for different axial lengths, thereby providing unambiguous terminal identification. As indicated in Fig. 3, I prefer that lead-wire retaining sockets or recesses or openings **16** be provided in angularly spaced plurality about the base or flange **13** to receive and provide alignment support for the wires **14—15**; four such recesses are shown for the case of the flange **13**, anticipating that for certain situations the body member **10—13** may be employed as the form on which two concentrically supported transformer windings are received, there being then one socket or opening **16** for each of the leads for the various transformer windings. Such a transformer will be more fully disclosed in connection with Fig. 4.

For unambiguous ultimate circuit orientation, I prefer that the base or flange **13** be provided with a lobe **17** or other key means, whereby automatic-handling machinery may sense orientation and establish proper angular reference to the chassis to which the circuit components may be assembled. I also indicate my preference that plastic-bonding means such as an epoxy resin be employed to permanently secure the turns of the winding **10** to each other and intimately to the coil form **11** and adjacent portions of the flange **13**; for clarity, such bonding is not shown in the present drawings, but full potting is illustrated in said Goldsmith application, and partial potting is illustrated in pending Goldsmith application, Ser. No. 716,106, filed February 19, 1958.

In order to provide for adjustment of the electrical inductance of the coil **10**, the bore **18** of the stem or coil form **11** may be ribbed or otherwise formed to readily accommodate the threads of a ferrite or the like core member **19**, keyed at **19'** for adjustment, all as described in said application, Serial No. 626,175. It will be appreciated that by positively locating the coil **10** by seating the same against the flange **13**, I provide for maximum axial clearance between the inner end of coil **10** and the reduced end of the coil form **11**; this means a substantial length of the coil form within which core member **19** may be accommodated with minimum coupling to coil **10**, so that a maximum range of coupling adjustment is available.

The parts which have thus far been described may comprise a complete independently utilizable assembly, but I prefer that the assembly be encased, and have therefore shown a cup-shaped housing member **20** for the purpose,

The housing member **20** comprises a generally cylindrical body portion or skirt **21** having means such as a radially inward flange **22** at one end for substantially closing said one end when assembled to the stem or coil-form member **11**. The means for securing housing **20** to the body member **11** may simply be established by forming the coil-form portion **11** initially with such axial length as to project axially beyond the opening **23** in the flange **22** when the parts are initially assembled to each other. The projecting end of the coil form **11** may then be beaded over by heating techniques or by spinning, to the shape shown at **24**. I prefer that when employing a housing (as at **20**) to encase the body member **12** with its coil **10**, the casing **20** be formed integrally with key means, as at **25**, to facilitate unambiguous orientation, and I have shown the key means **17** of the base or flange **13** accurately located and received within the recess defined by the key **25** at the skirt of the housing **20**.

As indicated generally above, the body member **12** and housing **20** are adapted to receive transformer windings, namely, a winding in addition to the winding **10** described in connection with Figs. 1 to 3. Such a transformer configuration is suggested in Fig. 4 wherein the parts are shown in exploded relation. Corresponding parts have been given the same reference numerals, and the winding **10** has been shown as the inner winding of the transformer. The only difference between the winding **10** shown in Fig. 4 and the winding **10** shown in Fig. 1 is that the lead **15'** for one end thereof is formed with a slightly greater radial offset, or at least said lead **15'** must be formed with such offset as to permit reception of the turns of the other winding **30** radially between the lead wire **15'** and the body of the winding **10**. The winding **30** is preferably also formed of the same insulated relatively stiff wire as the winding **10**, and with leads **31—32** projecting integrally beyond one axial end at locations spaced angularly from each other and from the angular location of the leads **14—15'**, as for example to be received in the remaining available lead-locating recesses **16** in the base or flange **13**.

It will be understood that, upon assembly, coil **10** will be concentrically supported on the coil form or stem **11** and that coil **30** will be concentrically supported by coil **10**. Depending upon the relative axial length of the two windings **10—30**, one or both of them may be axially located against the flange **13**, and preferably a plastic bonding compound, such as an epoxy resin, is employed to intimately secure the turns of both windings to each other in concentrically located relation and to the coil form and to the adjacent face of the flange **13**. The same closure cap or housing **20** may be employed and may be secured to the body member **12** in the manner discussed in connection with Figs. 1 to 3, in which case the bonding compound also preferably establishes a secure bond of the coils and flange **13** to the skirt **21**; this result may be achieved by sending a sufficient heating current through one or both coils **10—30**, to cause enough potting compound to flow into contact with skirt, and by thereafter cooling to establish a permanent bond. In the case of Fig. 4, as with the case of Figs. 1 to 3, the projecting lead ends **14—15'** and **31—32** are of such length compared with the weight and size of the completed assembly that they provide the substantial mounting support for the entire structure, and no additional parts or soldering connections are necessary to complete the assembly.

The arrangement of Fig. 5 in all respects resembles that already described for Figs. 1 to 3 and 4, except that the closure cap or housing **20'** is secured to the body member **12** at the skirt end of the member **20'**, rather than at the flanged end **22'** thereof. Thus, the skirt **21'** may be radially inwardly deformed at **35** into permanent locating relation with adjacent parts of the flange **13** of body member **12**. This may complete the assembly, but, as indicated above, I prefer to heat the coil or the coils in order to further melt and consolidate the bonding, thereby establishing a permanent bond of the turns to each other, as well as to the coil form and to the housing **25**.

In the arrangement of Fig. 6, the body member **40** is a bobbin having a coil-form portion **41** with radially outwardly extending flanges **42—43** at both axial ends thereof. The flange at **43** may be formed with wire-locating recesses **16**, as described in Fig. 3; also, the winding **10** may be as described in Figs. 1 to 3, and the leads **14—15** received in the flange **43** as described in Figs. 1 to 3 for the flange **13**. The employment of flanges **42—43** at both ends of the body member **40** permits the use of simpler extruded tubular material for the housing or closure member **44**, the same being shown as formed over at **45** into permanent retaining relation with the flange **42**. This operation may or may not be necessary, depending upon whether the potting agent is caused to flow before or after assembly to the housing **44**. I indicate my preference for completing the potting after assembly of the housing member **44**, whereby potting material may flow into and establish intimate contact with the coil or coils, with the coil form **41**, and with at least the lower end of the inner wall **44'** of the housing, so that all parts are permanently secured in place.

It will be seen that I have described a relatively simple yet efficient coil construction lending itself to automated fabrication and to automated later assembly into a circuit sub-assembly, as into a printed circuit, the key means **17—25** being such as to facilitate unambiguous location in such assembly. 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 described in the claims which follow.

I claim:

1. In combination, a flanged tubular coil-supporting body member, comprising an elongated tubular coil-form portion with a radially outwardly extending integral flange at one end, and an electrical winding comprising turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of said body of said coil-form portion, the rim of said flange having openings to receive the wire of said winding, and the ends of said winding being straight and integrally formed with said winding to project through and derive alignment support from said openings and to project axially beyond the axial end of said body member, the stiffness and weight of said wire being such that the projecting ends of said winding provide essentially the full mounting support of said combination.

2. In combination, a flanged tubular coil-supporting body member, comprising an elongated tubular coil-form portion with a radially outwardly extending integral flange at one end, and an electrical winding comprising a single layer of turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of said body of said coil-form portion, the rim of said flange having openings to receive the wire of said winding, the ends of said winding being straight and integrally formed with said winding to project through and derive alignment support from said openings and to project axially beyond the axial end of said body member, and plastic bonding means permanently securing the turns of said winding to said coil-form portion, the weight and stiffness of said wire being such that said projecting wire ends may provide the substantial mounting support for said combination.

3. In combination, a flanged tubular coil-supporting body member, comprising an elongated tubular coil-form portion with a radially outwardly extending flange at one end, and an electrical winding comprising turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of said body of said

coil-form portion, the rim of said flange having openings to receive the wire of said winding, the ends of said winding being straight and integrally formed with said winding to project through and derive alignment support from said openings and to project axially beyond the axial end of said body member; a generally cup-shaped housing member defining a cylindrical outer wall, said housing member having means at one end thereof for engagement with said coil-form portion, and means at the other end for engagement with said flange; and means permanently securing said housing to said body member at one of said ends, the weight and stiffness of said wire being such that the projecting ends of said winding may provide essentially the full support of said combination.

4. The combination of claim 3, in which the axial length of said body member with respect to said housing is such that said coil-form portion projects axially beyond the corresponding end of said housing when initially assembled together, said projecting portion being permanently deformed into radially overlapping engagement with the adjacent portion of said housing.

5. The combination of claim 3, in which the axial length of said housing with respect to said body member is such that when initially assembled to each other, the end of said housing adjacent said flange projects axially therebeyond, said projecting portion of said housing being permanently inwardly deformed into radially overlapping retaining relation with said flange.

6. In combination, a plastic tubular coil-supporting body member defining a coil form, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of the tubular body member, said body member being formed at one end with an integral radially outwardly extending flange against which turns of said winding are axially located, the ends of said winding being straight and integrally formed with said winding to project axially beyond said axial end of said body member, said flange having guide openings supporting said winding ends in angularly spaced relation with respect to the coilform axis, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, and plastic-bonding means permanently fixing said winding to said body member.

7. In combination, a plastic tubular coil-supporting body member defining a coil form, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of said tubular body member, said body member being formed at one end with an integral radially outwardly extending flange against which turns of said winding are axially located, said flange having angularly spaced openings for the ends of said winding, the ends of said winding being straight and integrally formed with said winding to project through the openings of said flange and axially beyond said axial end of said body member, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, plastic bonding means permanently fixing said winding to said body member, and a housing comprising a cup-shaped generally tubular member, including a generally cylindrical outer wall with an integral radially inwardly extending flange at one end thereof and engaging the coil-form portion of said tubular body member, the skirt of said housing at the other end thereof having means engaging the flanged end of said body member.

8. In combination, a plastic, tubular coil-supporting body member integrally formed at one end with a radially

outwardly extending retaining flange, a first winding comprising a first plurality of turns of relatively heavy and stiff wire deriving concentric support directly from the outer wall of said body member, a second winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support from said first winding, the wire ends for said windings projecting straight and axially through said flange at angularly spaced locations, the weight and stiffness of said wires being such that said projecting wire ends may provide the substantial mounting support for said combination, one of said windings being seated against said flange, and plastic-bonding means permanently fixing said windings to each other and to said body member.

9. In combination, a plastic tubular coil-supporting body member comprising a tubular coil-form portion between integral radially outwardly extending flanges at both axial ends, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from said coil-form portion, the ends of said winding being straight and integrally formed to project axially through one of said flanges and beyond the adjacent axial end of said body member, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, and plastic-bonding means permanently fixing said winding to said body member.

10. In combination, a plastic tubular coil-supporting body member comprising a tubular coil-form portion between integral radially outwardly extending flanges at both axial ends, an electrical winding comprising a plurality of turns of relatively heavy and stiff wire deriving concentric support directly from said coil-form portion, the ends of said winding being straight and integrally formed to project axially through one of said flanges and beyond one axial end of said body member, the weight and stiffness of said wire being such that said projecting wire ends provide the substantial mounting support for said combination, plastic-bonding means permanently fixing said winding to said body member, and a tubular housing closure member engaging both said flanges and effectively closing the annular space within which said winding is developed.

11. In combination, a plastic coil-supporting body member comprising a first elongated tubular coilform part integrally joined at one axial end to a second radially outward flange part, an electrical winding comprising a plural-turns portion integrally joined at the respective ends thereof to two lead portions, said winding being of relatively heavy and stiff wire and the turns portion deriving concentric support directly from the outer wall of said coilform part, said lead portions being straight and integrally formed to project through and derive alignment support from said flange portion and to project axially beyond said axial end, the weight and stiffness of said wire providing the substantial mounting support for said combination, and plastic-bonding means permanently securing said winding to said body member at the juncture of one of said portions with one of said parts.

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