United States Patent

Lane

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[54] BOBBIN WOUND COIL ASSEMBLY AND ELECTRICAL TERMINALS THEREFOR

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[52] **U.S. Cl.** .....**336/192**, 339/221 M, 339/275 T

[51] **Int. Cl.**.....**H01f 15/10**

[58] **Field of Search** .....336/192; 339/221 R, 221 M, 339/275 T

[56] **References Cited**

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Primary Examiner—E. A. Goldberg

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[57] **ABSTRACT**

An electrical bobbin wound coil assembly has electrical terminals secured within recesses formed in at least one flange of the bobbin, with the terminals being adapted for making welded connections thereto of either insulated or stripped terminating ends of coils and associated external leads. Each terminal is readily formed out of strip stock, bent at a sharp angle into an essentially V-shaped configuration, and has a stop-defining protruberance and a stop-defining bend formed at different points along at least one leg of the terminal. These stops, in conjunction with the inherent spring-bias clamping action of the legs of the terminal, temporarily position and hold the coil and lead ends at different desired elevations prior to their being permanently secured, preferably by welding, to the terminal. An L-shaped slot, associated with each terminal, extends outwardly from and is integral with a flange of the bobbin. The slot provides a means to firmly anchor an external lead to the bobbin in a manner which protects the lead-terminal connection from deleterious stresses which could otherwise be encountered during assembly, handling or use.

9 Claims, 4 Drawing Figures

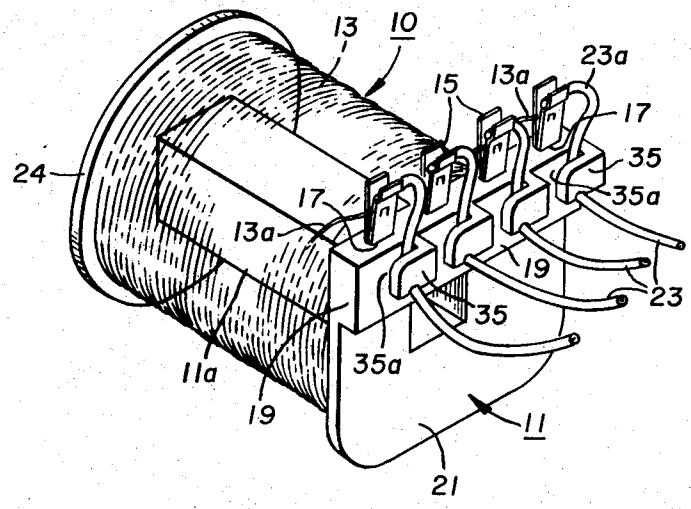


FIG. 1

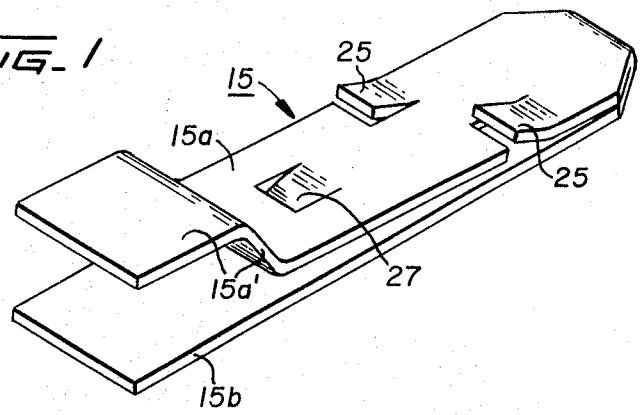


FIG. 2

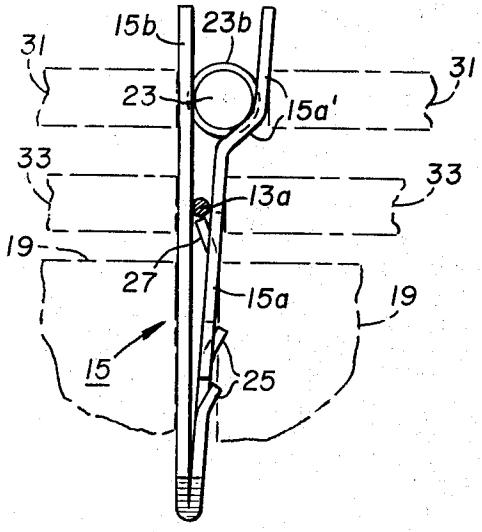


FIG. 3

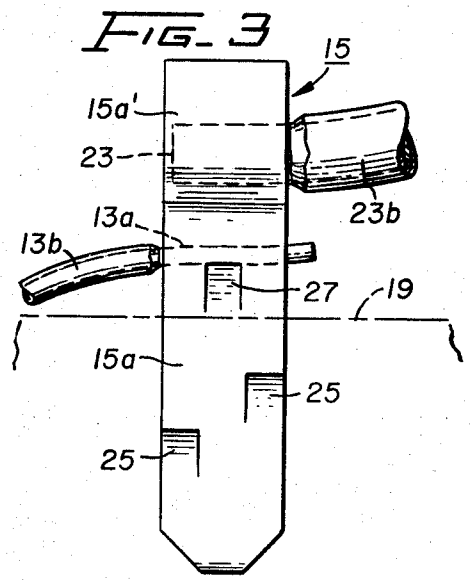
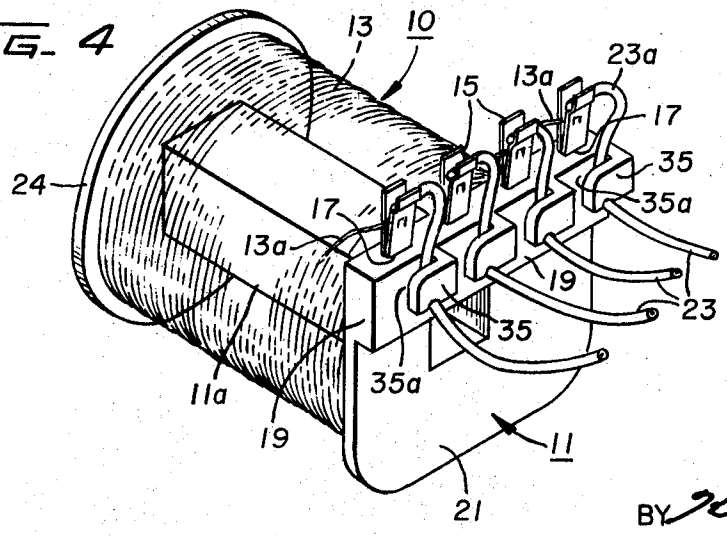


FIG. 4



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BOBBIN WOUND COIL ASSEMBLY AND ELECTRICAL TERMINALS THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to electrical coil assemblies and, more particularly, to those having bobbin-wound wire coils which terminate in permanent connections with associated electrical terminals secured to the bobbin.

2. Description of the Prior Art

Electrical coil assemblies of the type of particular interest herein may take many diverse forms, having either single or multiple windings, with the bobbins typically being formed out of molded plastic and having an elongated core-wound coil portion and integral coil-confining flanges at the ends thereof. Such bobbins also may employ one or more lead-in and/or lead-out slots formed in one or both inner walls of the flanges.

While such prefabricated bobbins lend themselves to mass produced automated manufacture of coil assemblies, problems have been encountered heretofore in making reliable terminating connections not only between the terminating ends of a bobbin wound coil (or coils), but to external leads associated therewith. More specifically, solder connections have generally been employed heretofore to permanently secure the terminating ends of the coil(s) and external leads to the associated terminals. Unfortunately, solder connections have not proven to be a panacea with respect to producing reliable, electrical terminations, particularly when attempted on a mass production basis. For example, the use of solder necessitates that enamel coated wire, which is generally employed for electrical coils, must be stripped at the terminating ends thereof in order to effect reliable solder connections with associated terminals. The need for wire stripping becomes particularly time consuming and expensive when multiple coil windings are employed in a given electrical coil assembly.

Similarly, external lead wires, which most often have a plastic insulating covering or jacket, must also be stripped at their terminating ends if they are to be soldered to an associated terminal. The number of such lead wires employed, of course, normally increases in direct relation to the number of coil windings required.

In addition, in applications where the electrical coil assembly is of small or miniaturized size, and where automated flow or fountain solder systems are desired for mass production applications, the solder often has a tendency to bridge across closely spaced terminals, or to produce icicles on the terminals that are often detrimental to the subsequent securement of external lead wires, hereinafter referred to simply as leads, to the terminals. Moreover, in the case of miniaturized coil assemblies wherein the terminals do not extend an appreciable distance outwardly from the edge of the flange and/or outer surface of the coil, it is often very difficult to position reliably such small coil assemblies so as to have only the desired portion of each terminal exposed to the molten solder. Concomitantly, in situations where a coil assembly is to be subsequently interconnected to associated electrical circuitry on a supporting substrate, circuit board or terminal block, for example, the heat generated by molten solder often may prove injurious to other closely spaced electrical circuitry, components or devices.

Another problem involved in not only the fabrication but subsequent handling of electrical coil assemblies is that deleterious tensional stresses are often inadvertently exerted on the external leads. Such stresses often result either in the breaking of the leads or in defective connections.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide an improved bobbin wound coil assembly having improved means for electrically connecting the terminating ends of the coil winding(s) and associated external leads to the assembly.

It is another object of the present invention to provide a coil assembly wherein un-stripped, insulated terminating ends of both a wound coil (or coils) and associated external leads may be reliably secured to electrical terminals of the bobbin on an automated basis, and without subjecting the coil assembly to deleterious heat.

It is a further object of the present invention to provide an electrical coil assembly wherein the bobbin thereof, with terminals secured thereto, includes integral lead anchoring means which isolate the lead-terminal connections from any tensional stresses exerted on the leads.

It is still an additional object of the present invention to provide an improved electrical terminal for use with bobbin wound coil assemblies, the terminal being formed out of strip stock, machine insertable within pre-formed recesses in a flange edge of the bobbin and adapted for making welded connections thereto of un-stripped wires of different gauge and having different types of non-conductive or insulating coatings thereon.

In accordance with the principles of the present invention, the electrical coil assembly in one preferred embodiment comprises a plastic molded bobbin having an elongated core, upon which one or more coils of wire are wound, and having a coil confining flange at each end of the core. At least one flange is formed with suitable terminal receiving recesses, and further includes an integral, outwardly extending L-shaped slot or channel associated with each terminal recess to anchor firmly, by clamping action, an external lead to the bobbin. Such a slot protects the terminating end section of the external lead between the slot and terminal from being subjected to excessive tensional forces which are often encountered during assembly, or through handling or during use thereafter. Such forces heretofore have often been found to produce a break in the lead or to result in a defective connection with the terminal.

In accordance with one illustrative embodiment, each of the electrical terminals associated with the coil assembly is adapted for making at least two welded connections thereto, one being with a terminating end of a bare or enamel-coated coil wire (normally of fine gauge), and the other with a terminating end of an external lead (normally of larger diameter and typically plastic covered).

The terminal is formed out of strip stock and is bent at a sharp angle into an essentially V-shaped configuration. As such, when the vertex end of the terminal is force-fit inserted into a pre-formed recess of a bobbin, for example, the legs are spring-biased toward each other so as to provide a clamping action to temporarily hold the coil and lead ends after being inserted therebetween.

A stop-defining protruberance and a peculiarly shaped stop-defining angle formed in at least one terminal leg positions the coil and external lead ends at different desired elevations, when inserted between the legs of the terminal.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an electrical terminal in accordance with one preferred embodiment of the invention;

FIG. 2 is an elevation edge view of the electrical terminal depicted in FIG. 1, illustrating typical positions of a terminating end of an enamel-coated coil wire and of a terminating end of a plastic covered external lead after having been welded to the terminal, and further illustrating, in phantom, both the insertion of the terminal within a pre-formed recess in the flange of an associated bobbin, and the manner in which two pairs of typical welding electrodes are positioned so as to effect welded terminal connections;

FIG. 3 is a side elevational view of the terminal, with a portion of the bobbin flange shown in section, illustrating typical welded connections of one terminating end of an enamel-coated coil wire and one terminating end of a plastic covered external lead to an associated terminal, with a portion of the enamel coating and plastic covering being shown as volatilized in the weld areas as a result of the heat generated during the welding operation, and

FIG. 4 is a perspective view of an electrical coil assembly in accordance with the principles of the present invention, and illustrates one of two typical coils (in phantom) coaxially wound about the core of the bobbin, integral lead anchoring means associated with one flange of the bobbin, and a plurality of electrical terminals of the type conducive to making welded coil and lead connections thereto.

DETAILED DESCRIPTION

In accordance with the principles of the present invention, and with specific reference to one preferred embodiment thereof as depicted in FIG. 4, an electrical coil assembly **10** is comprised of a bobbin **11**, a pair of coaxially wound wire coils **13** (only one shown in phantom) and a plurality of essentially V-shaped electrical terminals **15**, preferably blanked out of strip stock, such as of phosphor bronze. The terminals **15** are preferably force-fit into pre-formed recesses **17** formed in an outwardly protruding boss **19**, which forms an integral part of an end flange **21** of the electrical bobbin **11**. As thus mounted, the terminals provide a means whereby welded connections may be made between the four terminating ends **13***a* of the pair of coaxial wound coils **13** and the respectively associated terminating ends **23***a* of external leads **23**. Another end flange **24**, without terminals in the illustrative embodiment, defines, with flange **21**, the space in which the coils **13** are wound upon a core **11***a* of the bobbin.

With the terminals advantageously being constructed so as to facilitate the making of welded connections thereto, neither the terminating ends of the coils nor of the associated external leads need be stripped of any non-solderable coatings or insulation prior to effecting such weldments. This advantageously is possible because the heat generated during a welding operation effectively either burns away or volatilizes the coating or insulation, the particular end result depending on whether the outer covering comprises enamel, plastic, rubber or cloth.

As both the gauge of the wire and the type of coating or insulation thereon may often differ appreciably between the coil(s) and associated external leads, the terminal must be formed with wire clamping and stop areas of peculiar configuration.

In accordance with one preferred illustrative embodiment, and with particular reference to a single terminal of the type depicted in FIG. 1, it is bent at a sharp angle into a substantially V-shaped configuration, with one leg **15***a* thereof formed near the vertex end with several outwardly extending protruberances or barbs **25** to facilitate permanent, force-fit securement of that end of the terminal within a given pre-formed recess **17** of the bobbin **11**, for example. These barbs, of course, are dimensioned and oriented to produce a spring-biased locking action. An inwardly extending protruberance **27** formed along an intermediate region of the leg **15***a* acts as a stop to properly position a terminating end **13***a* of a bobbin wound wire coil **13** at a desired elevation, with the mutually opposed inner surfaces of the legs **15***a*, **15***b* of the terminal temporarily maintaining the inserted wire at the desired location through inherent spring-biased clamping action.

An upper terminating end region **15***a'* of the leg **15***a* is bent outwardly at an angle and then bent upwardly so as to not only increase the spacing between the two legs sufficiently to accommodate, but frictionally engage the terminating end **23***a* of a given external lead **23**, normally having an insulating coating or jacket **23***b* thereon. The bend region **15***a'* also acts as a positioning welding stop for the lead.

It is to be understood, of course, that any desired number of protruberances or barbs **25** may be formed in either leg **15***a* or **15***b*, or in both, to provide the necessary gripping or locking action when the vertex end of the terminal is force-fit within a receiving recess formed in the flange of the bobbin. Similarly, it should be understood that more than one stop-defining protruberance **27** and more than one stop-defining bend region **15***a'* may be formed in either one or both legs of each terminal so as to accommodate more than two terminating wire ends.

With the terminals **15** inserted within the pre-formed receiving recesses **17** of the bobbin, as best seen in FIG. **2**, the legs **15***a*, **15***b* of each terminal are inherently spring-biased toward each other so that when the terminating end **13***a* of a wire coil **13** and the terminating end **23***a* of an associated external lead **23**, for example, are inserted between the legs, the latter will frictionally engage and temporarily clamp such wire ends at the desired elevations, thereby insuring their subsequent alignment with mutually opposed pairs of welding electrodes **31** and **33** (shown only in phantom in FIG. **2**), which are employed to effect permanent weldments. After a welding operation, the insulation **23***b* on the terminating end of each lead **23**, and any enamel coating **13***b* on the terminating end of each coil are either burned away or volatilized as a result of the heat generated during the welding operation. As a result, permanent, reliable welded connections of the type depicted in FIG. **3** are produced.

It is readily appreciated, of course, that if conventional solder connections were to be made, any non-solderable enamel coating on the terminating ends of the bobbin wound coils and any insulation on the external leads would first have to be stripped therefrom. Thus, the electrical terminals **15** embodied herein greatly facilitate the manufacture of electrical coil assemblies, such as of the type depicted in FIG. **4**.

In accordance with another aspect of the present invention, the outwardly protruding boss **19**, formed as an integral part of the flange **21** of the bobbin, has a plurality of L-shaped anchoring details **35** integrally formed as an extension of the boss, each L-shaped detail being associated with a different terminal **15** of the electrical coil assembly **10**. The slot-defining space **35***a* formed by each L-shaped detail **35** is dimensioned so as to frictionally engage and reliably clamp an external lead **23** of given diameter within the slot.

In this manner, any tensional stress exerted on a particular external lead on the side of the associated slot opposite the terminal, such as during fabrication of the coil assembly, or through handling, packaging, shipping or even normal use, will not be transmitted to the welded connection. Such stresses heretofore have often produced intermittent electrical continuity or open circuit conditions at the terminal connection.

It is to be understood, of course, that any number of electrical terminals **15** and L-shaped details **35** may be employed in a given electrical coil assembly. More specifically, such terminals and L-shaped details may be associated with not only one edge of a given flange, but could readily be employed on both end flanges when multi-bobbin wound coils are required for a given application.

With respect to the molded bobbin **11** itself, it should also be readily understood that the bobbin may take any one of a number of different forms so as to satisfy a given application. For example, the bobbin may have only a single flange, or two or more flanges having any one of a number of different shapes. Concomitantly, either one or both inner walls of the end flanges may have lead-in and lead-out slots (not shown) formed therein so as to satisfy any particular electrical coil assembly application. As for material, the bobbin may be molded from many types of resinous materials, such as nylon, polystyrene, Bakelite, polyethylene, as well as others that have good dielectric properties and are readily adapted to cavity-formed molding.

In summary, a unique electrical coil assembly, including a bobbin with integral external lead anchoring details and peculiarly shaped terminals adapted for making welded wire connections thereto, has been described in accordance with one preferred embodiment. The terminals advantageously are constructed in a manner that not only facilitates their manufacture from strip stock material, but allows either uninsulated or insulated terminating coil and external lead ends to be secured thereto, initially through the inherent clamping action of the terminal legs, and subsequently by permanent weldments, with any insulation being effectively burned away or volatilized by the heat generated during the welding operation. Through the use of the lead anchoring details, the welded

connections are also substantially isolated from deleterious tensional stresses to which they could otherwise be subjected during assembly, handling, shipping or use.

What is claimed is:

1. In an electrical coil assembly including a bobbin formed of insulating material, having at least one end flange and a core upon which at least one coil of wire is wound:

at least one electrical terminal secured to the flange, said terminal being formed into a substantially V-shaped configuration with at least one inwardly extending protruberance formed along an intermediate region of one leg thereof so as to provide a stop to properly position a terminating end of the bobbin wound coil at a desired elevation between and in frictional engagement with the mutually opposed inner surfaces of the legs of the terminal, and an upper terminating end region of at least one leg of the terminal being bent outwardly at an angle and then bent upwardly so as to provide a space between the two legs of the terminal of sufficient width to accommodate, and of predetermined depth to provide a stop for, a terminating end of an external lead.

2. In an electrical coil assembly in accordance with claim 1, said terminal further including at least one outwardly extending protruberance formed in at least one leg thereof near the vertex end of the terminal, said last-mentioned protruberance being adapted to spring-bias against and frictionally engage a side wall partially defining a terminal receiving recess of a bobbin when inserted therewithin.

3. An electrical coil assembly comprising:

a pre-formed bobbin of insulating material having at least one end flange and a core;

at least one coil of wire wound upon the core of said bobbin, and

at least two electrical terminals secured to at least the one flange of said bobbin, each terminal including means to effect an electrical connection with at least a terminating end of said coil and an external lead, each of said terminals being formed into a substantially V-shaped configuration with at least one inwardly extending protruberance formed along the intermediate region of one leg thereof so as to provide a stop to properly position a given terminating end of said coil at a desired elevation between and in frictional engagement with the mutually opposed inner surfaces of the legs of the terminal, and an upper terminating end region of at least one leg of each terminal being bent outwardly at an angle and then bent upwardly so as to provide a space between the two legs of the terminal of sufficient width to accommodate, and of predetermined depth to provide a stop for, a terminating end of an external lead.

4. An electrical coil assembly in accordance with claim 3 wherein a separate pre-formed recess for receiving each terminal is formed in the periphery of at least said one flange, each of said recesses being dimensioned so as to spring-bias the legs of the associated terminal toward each other when said terminal is force-fit therewithin, and wherein said terminal further includes at least one outwardly extending locking protruberance formed in at least one leg thereof near the vertex end of the terminal, said locking protruberance being oriented and dimensioned so as to have sufficient resiliency to spring-bias against a side wall partially defining the receiving one of said recesses in the flange of said bobbin and, thereby, reliably secure the terminal to the bobbin.

5. An electrical coil assembly in accordance with claim 4 wherein the outer wall of at least said one flange is formed with at least one separate integral L-shaped anchoring detail associated with each terminal, said detail being dimensioned to provide a slot within which an external lead may be frictionally anchored.

6. An electrical coil assembly in accordance with claim 3 wherein the variable space defined between the legs of each terminal and the particular location and dimensions of the stop-defining protruberance and of the stop-defining upper bend region in at least said one leg of the terminal are chosen so as to selectively accommodate non-conductive coated, unstripped terminating coil and external lead ends and to temporarily hold them in desired positions, by the inherent spring-bias clamping action of said legs, in preparation for welding electrodes to be brought into contact with an to effect permanent welded terminal connections, with the coil and lead coatings in the areas of the welds being volatilized by the heat generated during the welding operation.

7. An electrical terminal capable of being formed out of strip stock and being particularly adapted both for force-fit insertion within a recess pre-formed within a flange of an electrical coil bobbin, and for making welded connections thereto of at least one terminating end of both a bobbin wound coil and an external lead, said terminal comprising:

two integral leg portions bent at a sharp angle into an essentially V-shaped configuration, at least one of said legs being formed with at least one outwardly extending locking protruberance near the vertex end of the terminal to facilitate permanent, force-fit securement of that end within a recess of a bobbin, at least one of said legs also being formed with an inwardly extending protruberance along an intermediate region thereof so as to act as a stop to properly position at least one terminating end of a bobbin wound coil at a desired elevation between and in frictional engagement with the closely spaced legs of the terminal, said terminal further including an upper terminating end region wherein at least one of said legs is bent outwardly at an angle and then bent upwardly so as to provide a space between the two legs of the terminal of sufficient width to accommodate, and of predetermined depth to provide a stop for, at least one external lead at a desired elevation.

8. An electrical terminal in accordance with claim 7 wherein at least one leg of said terminal is provided with at least one protruberance in the form of a barb near the vertex end thereof, said protruberance extending not only outwardly but upwardly toward the free end of the common leg and being dimensioned to have sufficient resiliency so as to spring-bias against and effectively lock the inserted portion of the terminal within a pre-formed recess of a bobbin.

9. A terminal in accordance with claim 8 wherein the variable space defined between the legs of said terminal and the particular location and dimensions of the stop-defining protruberance and of the stop-defining upper bend region in at least said one leg of the terminal are chosen so as to selectively accommodate insulated, un-stripped terminating coil and external lead ends and to temporarily hold them in desired positions, by the inherent spring-bias clamping action of said legs, in preparation for welding electrodes to be brought into contact with and to effect permanent welded terminal connections, with any coil and lead insulation in the areas of the welds being volatilized by the heat generated during the welding operation.

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