United States Patent [19]

Dawson et al.

[11] **3,848,208**

[45] **Nov. 12, 1974**

[54] **ENCAPSULATED COIL ASSEMBLY**

[75] Inventors: **Carlyle Steven Dawson,** Normal; **Dorsey Lorraine Hardman,** Lexington, both of Ill.

[73] Assignee: **General Electric Company,** New York, N.Y.

[22] Filed: **Oct. 19, 1973**

[21] Appl. No.: **407,791**

[52] **U.S. Cl.** **336/96,** 336/192, 336/208

[51] **Int. Cl.** **H01f 27/30**

[58] **Field of Search** 336/192, 198, 208, 96

[56] **References Cited**

UNITED STATES PATENTS

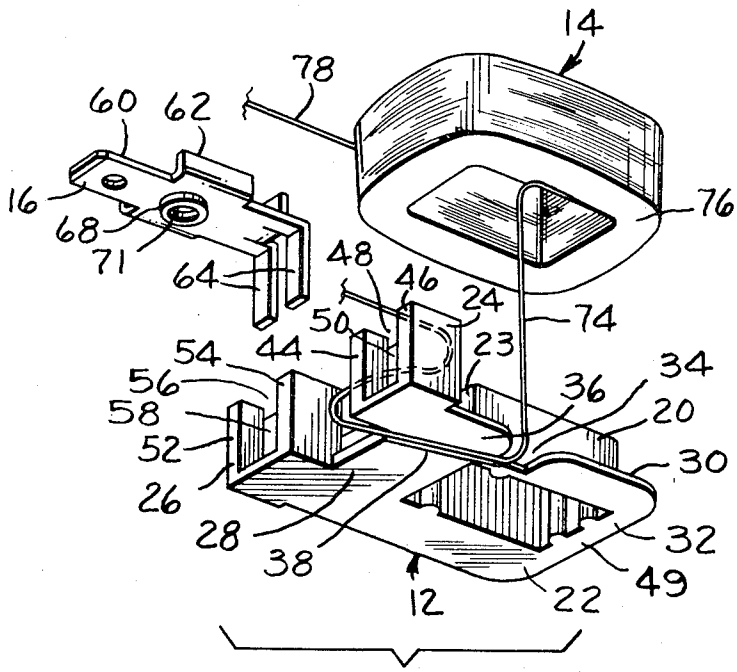
3,189,772	6/1965	Wingler et al.	336/198 X
3,189,857	6/1965	Jones	336/198
3,343,113	9/1967	Dougal	336/208 X
3,359,395	12/1967	Bruce	336/192 X
3,359,520	12/1967	Foerster	336/192
3,609,616	9/1971	Dumeige	336/192
3,731,245	5/1973	Roslin	336/198

Primary Examiner—Thomas J. Kozma
Attorney, Agent, or Firm—S. A. Young; P. L. Schlamp; R. G. Simkins

[57] **ABSTRACT**

A coil assembly comprising an electrically insulating support, a coil winding mounted on the support, and first and second terminal members. The support includes a main portion, a flanged portion extending from the main portion, and first and second terminal receiving sections extending from the lower periphery of the flanged portion for receiving the respective first and second terminal members. The flanged portion has a first surface contiguous with the main portion, a second surface opposite the first surface, an opening extending between the first and second surfaces, and a slot within the second surface extending from a point adjacent the first terminal receiving section to the opening in the flanged portion at a point adjacent the main portion. A start wire portion of the coil winding extends from the first terminal member, within the slot in the second surface and through the opening in the flanged portion to the main portion at a point adjacent the beginning of the first turn of the coil winding. A terminating wire portion of the coil winding extends from the end of the last turn of the coil winding to the second terminal member. The coil winding is containable within a conventional molded plastic encapsulating material.

4 Claims, 7 Drawing Figures



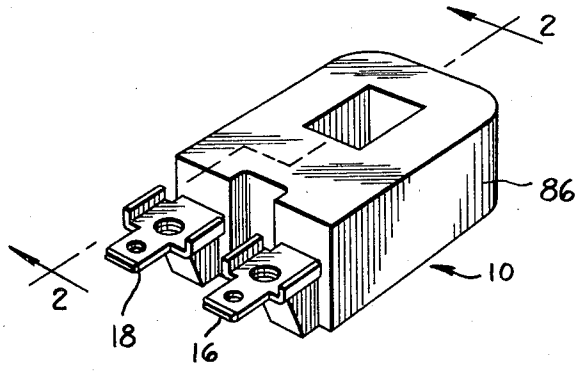


FIG. 1.

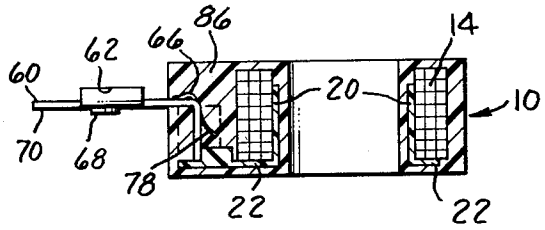


FIG. 2.

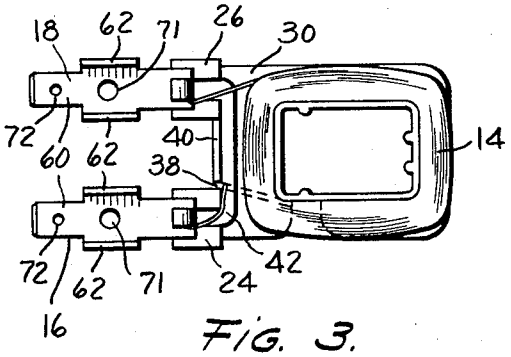


FIG. 3.

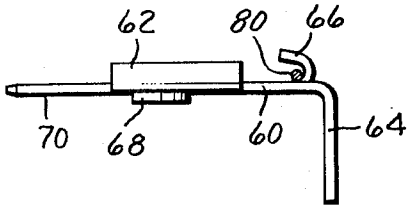


FIG. 5.

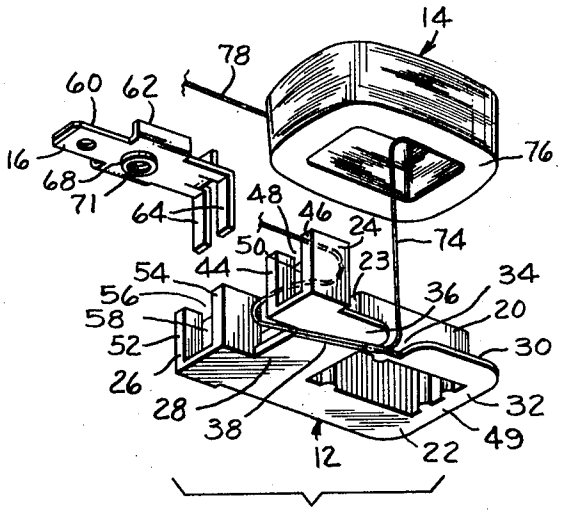


FIG. 4.

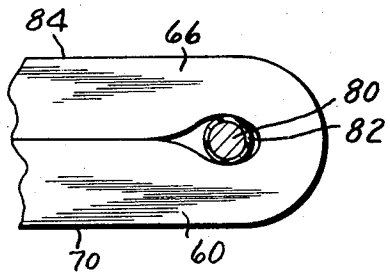


FIG. 6.

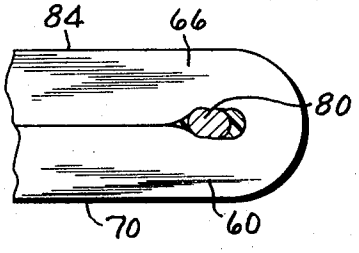


FIG. 7.

ENCAPSULATED COIL ASSEMBLY

BACKGROUND OF THE INVENTION

1. Field of The Invention

This invention relates to coil assemblies and more particularly to coil assemblies adaptable for mass machine manufacture.

2. Description Of The Prior Art

For many years coil assemblies have been manufactured which are comprised of coil windings and their respective supports as exemplified in U.S. Pat. No. 3,230,489 and 3,131,371. The coil winding generally consists of a multiplicity of wire turns which are coated with an insulative enamel material. The winding is positioned about a plastic insulative support which resembles a spool or a reel. The winding has a start wire which has its end soldered to a terminal member that is attached to the support. The start wire extends from the terminal member to a main portion of the support along an adjacent inner surface of a flanged portion which extends from the main portion. The terminating portion of the wire is soldered to another terminal member.

Quite often portions of insulative enamel wear away and adjacent turns of the coil winding are shorted together so as to reduce the effective number of turns of the coil winding. This however is a tolerable situation in view of the large number of coil turns involved. However, if the insulation of the start wire were to breakdown and the start wire were to become electrically shorted to one of the outer or latter coil turns, the usefulness of the coil assembly would be substantially destroyed, in view of the large number of intervening coil turns that would be electrically short circuited. In order to avoid the short circuiting of a large number of coil turns due to the breakdown in the insulation of the start wire, the start wire has often been taped to the inner surface of the flange, using an insulative material to separate the start wire from the remaining windings of the coil. However, the taping of the start wire to the inner surface of the flange is a manual operation, and is also time consuming and costly. Furthermore, the taping operation also renders it difficult to automate the manufacture of the coil assembly.

An alternative to the taping of the start wire of the coil winding to the inner surface of the flange of the support is described in U.S. Pat. No. 3,117,294. In this patent, a portion of the flange is greatly increased in thickness, and a pocket is formed between the inner and outer surfaces of the flange for accomodating the start wire, and thereby insulating it from the remaining turns of the coil windings. The inner surface of the flange also has a slot therein for communicating with the pocket for positioning the start wire in the pocket. However, the molding of a support, which has such an irregularly shaped flange, is difficult and costly. Furthermore, the thickness of that portion of the flange, which contains the pocket, would have to be greatly increased in order to overcome the structural weakness created by the existence of such a pocket. Still further, the positioning of the start wire through the slot in the inner surface of the flange and into the pocket would require a manual or cumbersome mechanical threading operation similar to that of the passing of a thread through the eye of a needle. Finally, it would still be possible for a loose intermediate or latter turn of the coil winding to slip through the slot in the inner surface of the flange and into the pocket so as to engage the start wire, and thus still cause a short circuiting of a substantial number of coil turns.

Furthermore, in coil assemblies of the prior art, the flanged portion and terminal receiving sections of the support, and the terminal members were often shaped in such manner as to block the flow of plastic material used to encapsulate the coil winding during the encapsulating step.

OBJECTS OF THE INVENTION

It is an object of this invention to provide a coil assembly of the type described above, wherein the short circuiting of the start wire of the coil winding to its latter coil turns is prevented.

It is another object of this invention to provide a support for a coil winding which conveniently prevents the short circuiting of a start wire to the latter turns of the coil winding described above in a simple convenient manner that does not interfere with the efficient manufacture of the final coil assembly.

It is a further object of this invention to provide a coil assembly having a support and terminal members which are adapted to facilitate the flow of plastic material during the encapsulation of the coil winding.

These and other objects of the invention will be pointed out in and understood from the following.

SUMMARY OF THE INVENTION

According to a broad aspect of the invention there is provided a coil assembly comprised of an electrically insulating support, a coil winding mounted on the support, and first and second terminal members. The support includes a main portion for receiving the winding, a flanged portion which extends from the main portion, and first and second terminal receiving sections for receiving the first and second respective terminal members. The flanged portion has a first surface contiguous with the main portion, a second surface opposite the first surface, an opening extending between the first and second surfaces, and a slot within the second surface extending from a point adjacent the first terminal receiving section to the opening in the flange portion at a point adjacent the main portion. The coil winding has a start wire portion, which is heat crimped to the first terminal member, and extends from the first terminal member to within the slot in the second surface of the flanged portion, then through the opening in the flanged portion to the beginning of the first turn of the coil winding on the main portion of the support. The coil winding also has a terminating wire portion, which is heat crimped to the second terminal member, and extends from the second terminal member to the end of the last turn of the coil winding. The opening in the flanged portion and appropriate openings in the terminal receiving sections and the terminal members provide for a decrease in resistance to the flow of plastic material during the molding and encapsulation of the coil assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the encapsulated coil assembly;

FIG. 2 is a cross-sectional view of FIG. 1 taken along lines 2—2;

FIG. 3 is a top view of the coil assembly prior to encapsulation;

FIG. 4 is an exploded bottom perspective view of the components of the coil assembly shown in FIG. 3;

FIG. 5 is a side view of a terminal member and a coil wire prior to the attachment of the coil wire to the terminal member;

FIG. 6 is an enlarged fragmentary view of the coil wire and the adjacent portions of the terminal member as the wire is in the process of being heat crimped to the terminal member; and

FIG. 7 is an enlarged fragmentary view of the coil wire and the adjacent portions of the terminal member after the wire has been heat crimped to the terminal member.

DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIGS. 1 through 4, a coil assembly 10 is comprised of a support 12, a coil winding 14, and first and second terminal members 16 and 18.

Support 12 is comprised of an insulative material, such as a thermoplastic polyester, and can be manufactured using standard injection molding techniques. Support 12 has a rectangularly shaped hollow main portion 20, a flat flanged portion 22 extending outwardly from one end of and at right angles to the outer surface 23 of main portion 20, and first and second terminal receiving sections 24 and 26 extending outwardly at right angles from a bottom section 28 of flanged portion 22. Flanged portion 22 has a first surface 30, which is contiguous with outer surface 23 of main portion 20, a second surface 32 opposite first surface 30, and an opening 34 in a side wall 36 of flanged portion 22 extending between the first and second surfaces of the flanged portion. Flanged portion 22 further includes a slot 38, within second surface 32, extending from bottom section 28 of flanged portion 22 at a point adjacent first terminal receiving section 24 to opening 34 at a point adjacent main portion 20. As more clearly shown in FIG. 3, slot 38 actually extends within a bottom peripheral edge 40 of flanged portion 22. A solid rib 42 extends from first surface 30 along bottom section 28 of flanged portion 22 and between first and second terminal receiving sections 24 and 26. Rib 42 increases the rigidity and structural strength of support 12 and more particularly flanged portion 22. First terminal receiving section 24 is U-shaped and has side walls 44 and 46 separated by a channel 48 which extends therethrough in the direction from a top section 49 to bottom section 28 of flanged portion 22. Side walls 44 and 46 are slotted for receiving terminal member 16. In FIG. 4 only a slot 50 in side wall 44 is shown. Similarly, second terminal receiving section 26 is U-shaped and is comprised of side walls 52 and 54 separated by a channel 56 that extends therethrough in the direction from top section 49 to bottom section 28 of flanged portion 22. Again side wall 52 and 54 are slotted for receiving terminal member 18. Also, in FIG. 4 a slot 58 in side wall 52 is shown, but the slot in side wall 54 is not shown.

Terminal members 16 and 18 are comprised of a suitable conductive material, such as brass. Each of terminal members 16 and 18 include a major section 60, rib sections 62 extending at right angles from the major section to provide structural strength to its respective terminal member, and a pair of cantilevered fingers extending from one end of and at right angles to major section 60. Fingers 64 are received within and engage the slotted walls of their respective terminal receiving section. Each of the terminal members further includes a pronged section 66 extending from the juncture between fingers 64 and major section 60 toward rib sections 62. Each of terminal members 16 and 18 also includes a boss 68 extending from a bottom surface 70 of major section 60, and a trapped hole 71 formed within major section 60 and extending through boss 68. Boss 68 serves the purpose of providing depth for the taped hole that is sufficient to accomodate the required number of tapped turns necessary to insure that a threaded terminal screw (not shown) is maintainable within the tapped hole. A hole 72 is also provided within the major section of each of the terminal members, and this hole serves as a means for mounting the coil assembly within another apparatus.

As shown in FIGS. 3 and 4, coil winding 14 is comprised of a start wire 74, a plurality of coil turns 76, and a terminating wire 78. The type of wire used, as shown in cross section in FIG. 6, in this instance, is round bare copper wire 80 which is covered with a clear transparent polyvinyl formal enamel insulative film 82.

The procedure for the manufacture of coil assembly 10 will now be described. Coil winding 14 is first formed to be self supporting. This is accomplished by coating the polyvinyl formal film surrounding the bare copper wire with a heat and solvent sensitive thermoplastic resin. Then the wire is passed over a felt pad saturated with denatured alcohol and heated to remove the alcohol during the actual winding of the coil. The fingers of the terminal members are positioned within the slotted walls of their respective terminal receiving sections and the formed coil turns 76 are positioned onto surfaces 23 of main portion 20 of the support. Start wire 74 is then led from the beginning of the first turn of the coil winding through opening 34 and into slot 38 of flanged portion 22, and then through channel 48 of terminal receiving section 24 to terminal member 16. Similarly terminating wire 78 extends from the end of the last turn of coil winding 14 through channel 56 of terminal receiving section 26 to terminal member 18. The respective ends of start wire portion 74 and terminating wire portion 78 are positioned between major section 60 and pronged section 66 of their respective terminal members 16 and 18, as shown in FIG. 5. Using standard heat crimping techniques and applying a typical welding pressure of 200 lbs. and welding current of approximately 4,000 amps to a surface 84 of pronged section 66 and surface 70 of major section 60 of respective terminal members 16 and 18, pronged section 66 becomes pressed against major section 60 so as to surround wire 80, as shown in FIG. 6. Finally, the heat generated by welding process in combination with the steady application of welding pressure causes the insulative enamel film 82 surrounding wire 80 to be at least partially burned away as portions of bare copper wire become welded and crimped to their respective terminal members, as shown in FIG. 7.

Then using a standard low pressure transfer or injection molding thermosetting epoxy compound and standard molding techniques, winding 14 and support 12 become encapsulated within a molded housing 86 shown in FIG. 1. The encapsulating material also encompasses that portion of the terminal members which have the respective start and terminating wires at-

tached thereto. The encapsulating material generally flows from top section **49** towards bottom section **28** of flanged portion **22** during the encapsulating step, wherein the material freely flows through opening **34** in flanged portion **22** and through the channel in each of the terminal receiving sections of support **12.** The flow of the encapsulating material through channel **48** of the terminal receiving section **24** causes pressure to be applied to the start wire so as to introduce a tension therein which results in the firm placement of the start wire within slot **38** of flanged portion **22** during the encapsulation step. This insures that, in the final assembly, start wire **74** is firmly positioned within slot **38** of flanged portion **22** and does not loosely extend therefrom. This further insures the start wire will not extend through the encapsulated molded housing, and will, in fact, still be safely insulated from coil turns **76** by flanged portion **22.**

Although the invention has been described with reference to a specific embodiment thereof, numerous modifications are possible without departing from the invention and it is desirable to cover all modifications falling within the spirit and scope of this invention.

What we claim as new and desire to secure by letters patent of the United States is:

1. An encapsulated coil assembly comprising:

a. an electrically insulative support including a main portion, a flanged portion extending from said main portion, and first and second terminal receiving sections, said flanged portion comprising top, bottom and first and second side sections having a first surface contiguous with said main portion and a second surface opposite said first surface, said first side section having an opening extending between said first and second surfaces and a slot within said second surface, the slot extending from said bottom section at a point adjacent said first terminal receiving section to the opening in said first side section at a point adjacent said main portion, each of said first and second terminal receiving sections extending from said bottom section and having a channel extending completely therethrough in a direction from the top section to the bottom section of said flanged portion;

b. first and second terminal members positioned within said first and second terminal receiving sections respectively;

c. a coil winding surrounding said main portion, said winding including a first turn, a last turn, a start wire portion and a terminating wire portion, said start wire portion extending from said first terminal, through the channel in said first terminal receiving section to within the slot in the second surface of said flanged portion, then through the opening in said flanged portion to said main portion and the beginning of said first turn of said coil winding, said terminating wire portion extending from the end of said last turn of coil winding to said second terminal member; and

d. encapsulating material surrounding said coil and said support, whereby during the encapsulation of said coil assembly, and while said encapsulating material is flowing in the direction from said top section toward said bottom section of said flanged portion and through the channel in said first terminal receiving section, sufficient pressure is applied to said start wire to insure firm placement of said start wire within the slot in the second surface of said flanged portion after completion of the encapsulation of said coil assembly.

2. A coil assembly according to claim **1,** wherein each of said first and second terminal members has a major section, a pair of cantilevered fingers extending at approximately right angles from said major section, and a pronged section extending from the juncture of said fingers and said major section.

3. A coil assembly according to claim **2,** wherein the channels of said first and second terminal receiving sections are slotted to receive said fingers of said first and second terminal members respectively.

4. A coil assembly according to claim **2,** wherein said start wire portion and said terminating wire portion are fixed between said pronged section and said major section of said first and second terminal members, respectvely.

* * * * *

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,848,208 Dated November 12, 1974

Inventor(s) Carlyle S. Dawson & Dorsey L. Hardman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 1, column 6, line 14, before "coil" insert - said -

Claim 4, column 6, lines 4 & 5 delete "respectvely" and insert - respectively

Signed and sealed this 20th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks

PO-1050
(5/69)

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,848,208 Dated November 12, 1974

Inventor(s) Carlyle S. Dawson & Dorsey L. Hardman

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Claim 1, column 6, line 14, before "coil" insert - said -

Claim 4, column 6, lines 4 & 5 delete "respectvely" and insert - respectively

Signed and sealed this 20th day of May 1975.

(SEAL)
Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents
and Trademarks