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ELECTRIC COIL CONSTRUCTION

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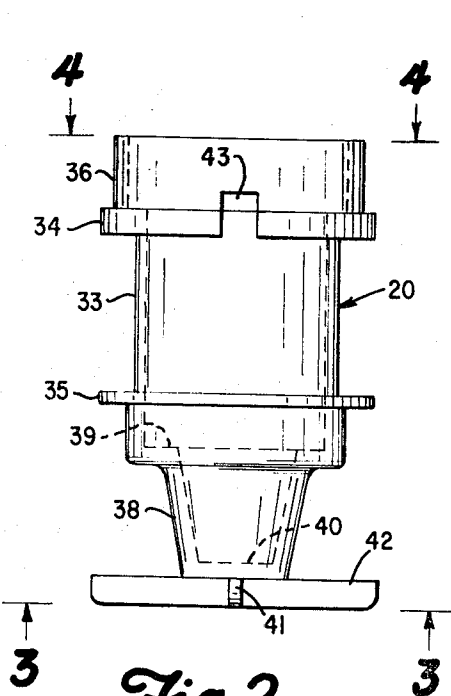


Fig. 2

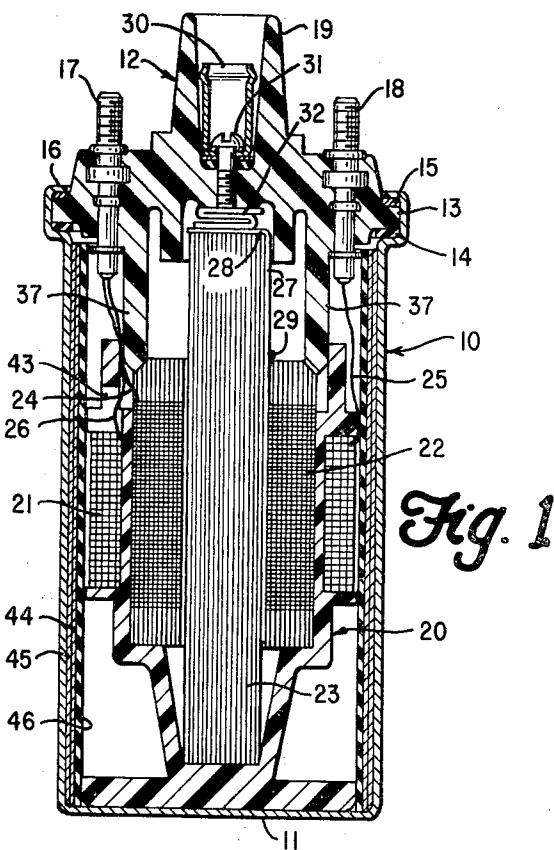


Fig. 1

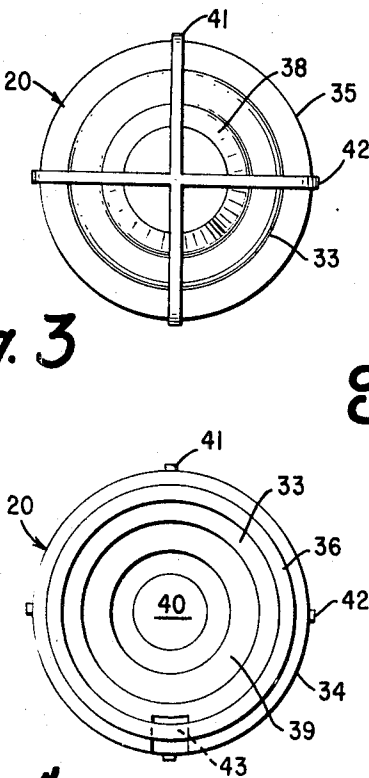


Fig. 3

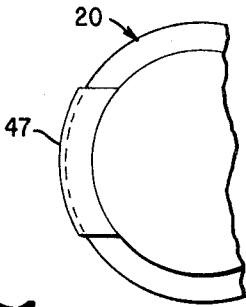


Fig. 6

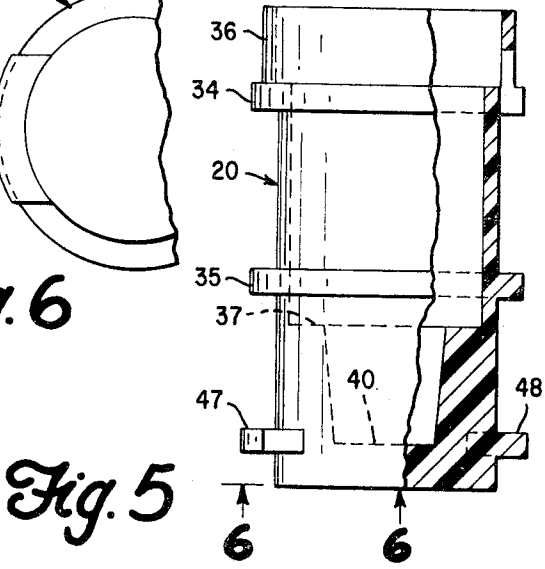


Fig. 5

Fig. 4

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ELECTRIC COIL CONSTRUCTION

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11 Claims

ABSTRACT OF THE DISCLOSURE

A construction for an electric coil which includes a one-piece hollow coil spool of a molded plastic material for positioning and supporting the primary and secondary windings within the coil can. The spool has a hollow cylindrical surface with spaced-apart circular flanges to define a support surface for the primary winding and a hollow interior having a closed lower end for receiving and supporting the secondary winding. A supporting leg at the lower end of the spool extends a radial distance substantially equal to the diameter of the coil can to coaxially position and support the spool and windings within the coil can.

This invention relates to an improved construction for an electric coil which includes a molded plastic spool for positioning and supporting the primary and secondary coil windings within the coil can. Through use of such a molded plastic spool, the primary and secondary windings are positioned and secured coaxially within the coil can, the primary and secondary windings are separated from one another by portions of the non-conducting spool, and all metallic fasteners such as staples or paper interlayers in the primary, as used in prior art constructions, are eliminated. The use of the molded plastic spool of this invention, in addition to providing a more rugged and trouble-free coil construction, simplifies the assembly of the coil constructions and has eliminated certain undesired variables which occurred in the production of prior art coils in which the winding support members were fabricated from materials requiring the use of fasteners such as staples or from layers of heavy paper between each of the primary layers.

In an electric coil, such as the automotive-type coil in which the low voltage power from the battery (12 volts) is applied to a low-turn primary winding to induce a high voltage pulse from the high-turn secondary winding, the primary and secondary windings are coaxially positioned on a laminated iron core and are placed within a cylindrical hollow coil can having a closed bottom and an open top which is closed by a molded coil cap. In coil assemblies of this type, the coil can and cap are joined by crimping the edge of the can over a lip on the edge of the cap after the windings, spool and core iron have been inserted in the can and proper electrical connections have been made.

In prior art manufacturing procedures, certain difficulties have been encountered in assembling the coils due to dimensional variations in the spool supporting the primary and secondary windings, and also due to the fact that the materials used for the spool, generally cardboard or other inexpensive, non-conductive materials, required staples or other metallic fasteners to form or secure beads or ridges to provide a supporting surface for the primary winding on the outside surface of the spool. In many instances of coil failure in an automobile it has been found that the vibration inherent in an automotive installation would cause a staple to work its way into contact with one of the conductors and to short out, for example, the secondary winding, thus causing coil failure. In other con-

structions where the primary is wound directly onto the secondary with paper interlayers, vibration and excessive pressure on the secondary windings would cause coil failure. In addition, assembly procedures which required the worker to coaxially position the windings and core relative to the can for proper placement of the cap was difficult due to dimensional variations and sometimes collapse of the cardboard supports. Finally, in order to separate the lower portion of the core laminations from the bottom of the coil can, it was necessary to provide a separate, non-conducting, often ceramic, disc or plug which increased the assembly and overall coil cost.

The above-outlined disadvantages of the prior art have been eliminated through use of the construction described in detail below, which will be understood from a description of a preferred embodiment thereof, with reference being made to the accompanying drawings in which:

FIG. 1 is a cross-sectional view in elevation of a complete coil construction using the improved coil spool of this invention;

FIG. 2 is a view in elevation of the coil spool used in the coil shown in FIG. 1;

FIG. 3 is a bottom end view of the coil spool shown in FIG. 2, taken along line 3—3 of FIG. 2;

FIG. 4 is a top end view of the coil spool shown in FIG. 2, taken along line 4—4 of FIG. 2;

FIG. 5 is a view in elevation, partly in cross section, of an alternate embodiment of a coil spool; and

FIG. 6 is a bottom end view of the coil spool shown in FIG. 5, taken along line 6—6 of FIG. 5.

Referring first to FIG. 1, the coil construction includes a metallic coil can 10 having a closed bottom 11 and an open top upon which is secured a coil cap, generally designated by reference numeral 12. The outer edge of the coil cap 12 has a rim 13 which, when assembled to the coil can 10, is placed between a gasket 14 and a steel washer 15 over which the edge 16 of the can 10 is crimped. A positive terminal 17 and a negative terminal 18 extend through the molded cap 12, as shown, and the high tension wire connection is centrally positioned within an upwardly-extending sleeve 19 which is coaxial with the coil can 10 and cap 12.

Coaxially positioned within the coil can 10 is the unitary molded plastic coil spool, generally designated by reference numeral 20, which supports, on its outer periphery, a primary winding 21. Inside the spool 20 is placed a secondary winding 22 which surrounds a laminar iron core 23 which extends substantially throughout the height of the coil can 10 and rests upon the bottom of the plastic spool 20, as will be subsequently explained.

The electrical connection of the coil, as known by those skilled in the art, may be varied to obtain certain advantages in output characteristics. The connections as follows are for illustrative purposes and are not deemed to constitute a part of this invention. One end of the primary winding 21 is connected by a lead 24 to the lower end of the positive terminal 17, while the other end of the primary winding 21 is connected by a lead 25 to the lower end of the negative terminal 18. One end of the secondary winding 22 is connected by a lead 26 to the bottom of a positive terminal 17, while the other end of the secondary winding 22 is connected to a conductive strip 27 which lies adjacent the laminar core 23 and has an end extending over the top of the core stack, as indicated by reference numeral 28. (The connection between the second end of the secondary winding 22 and the conductive strip 27 is schematically shown in FIG. 1 as designated by reference numeral 29, and in practice would be a soldered connection at the innermost layer of the secondary winding 22.) Finally, as seen in FIG. 1, a metallic terminal 30 within the sleeve 19 on the cap

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12 is connected by a metallic fastener, such as a screw 31, which extends through the cap 12 and bears against a conductive spring member 32 which is in electrical contact with the end 28 of the conductive strip 27. It will thus be apparent that the low voltage applied to the primary winding 21, when interrupted, will induce a high voltage pulse in the secondary which is applied to the spark plugs of an internal combustion engine through the distributor by a high tension lead connecting the distributor to the coil at the terminal 30.

Referring to FIG. 2, the coil spool 20 in its preferred form includes a hollow cylindrical member 33 having a pair of axially-spaced-apart, upper and lower circular flanges 34 and 35, respectively, which extend radially outwardly from the outer surface of the cylindrical member 33 a distance greater than the depth of the primary winding 21, as seen in FIG. 1. This has the advantage of preventing the outermost layer of turns of the primary winding 21 from striking any portion of the coil can 10 or its associated liners during the installation of the windings and spool within the can 10. In addition, during assembly of the coil, the flanges 34 and 35, along with the lowermost portion of the spool, to be subsequently described, assist in maintaining the spool and windings in coaxial alignment with the coil can 10 for insertion of the coil cap 12, as will be subsequently explained.

Extending above the upper flange 34 is a circular rim 36 whose inside diameter is adapted to receive a downwardly-extending skirt 37 on the underside of the cap 12, as shown in FIG. 1. The skirt 37 need not be a circular protrusion but can be at least three separate ribs which fit snugly inside the circular flange 35 so that, when the cap is installed upon the can in the manner previously described, the windings 21 and 22, core 23, and spool 20 are positioned and held coaxially with the can. In addition, the bottom edge of the skirt 37 bears firmly into the top of the secondary winding 22, which in turn applies pressure to the land 39 preventing any longitudinal movement of the winding 22, and spool 20. Longitudinal movement of the core 23 is prevented by compression of the conductive spring member 32 between the top of the core 23 and contact 31.

Below the lower flange 35 on the spool 20 is a supporting portion including an inverted frustoconical sleeve 38 whose larger upper diameter is smaller than the diameter of the cylindrical member 33 and is joined thereto by a radially-extending interior land 39. The smaller lower diameter of the frustoconical sleeve 38 has a closed bottom 40 which is supported by a pair of radially-extending legs 41 and 42, best seen in FIG. 3. The length of each of the legs 41 and 42 is substantially equal to the effective interior diameter of the coil can 10 plus its linings, as seen in FIG. 1, so that the spool 20, with the primary winding 21 wound thereon, is coaxially positioned within the can by the legs 41 and 42 alone. Finally, an aperture 43 through the wall of the spool adjacent the upper flange 34 is provided so that one end of the primary winding 21 may be led to the interior of the spool for connection to the lead 24 which connects to the positive terminal 17, as shown in FIG. 1. The aperture 43 also serves to accept a driver on the arbour when winding the primary winding 21 onto the bobbin.

As seen in FIG. 1, the secondary winding 22 is positioned within the cylindrical member 33 of the spool 20 with its lower edge resting upon the land 39. The laminated core 23 extends through the annular secondary winding 22 with its bottom end resting upon the bottom 40 of the spool with its top end in electrical contact with the end 28 of the conductive strip 27, as previously explained. With the cap 12 installed so that the protruding skirt 37 extends down into the circular rim 36 on the spool, the coil so constructed has the following features which assure its continued performance in adverse mechanical and temperature operating conditions. The windings 21 and 22 are held in concentric relation about

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the axis of the can 10 and the core 23 by the spool 20 which is positioned concentrically within the can 10 by the skirt 37 at the upper end and by the legs 41 and 42 at the lower end. In addition, the flanges 34 and 35 extend radially outwardly beyond the outer surface of the primary winding 21 to prevent any possibility of these turns being shorted against the interior of the can 10 if, for example, the can becomes dented or otherwise misshapen. As known to those skilled in the art, additional conductive layers 44 and 45 of a magnetic material in the form of semicircular shims may be placed alongside the interior of the walls of the can 10, along with a tubular cardboard sheet 46. The layers 44 and 45 increase the permeability along the walls of the can, and thus increase the transformer efficiency of the coil, while the cardboard 46, which may be eliminated, will assure that the primary or connecting leads would not be shorted out against the walls of the can, should an extreme dent occur in this area. The secondary 22 is positively separated from the primary winding 21 by the walls of the cylindrical member 33, and the laminated core 23 is separated from the can 10 by the bottom 40 and legs 41 and 42 of the spool 20, and by the non-conductive cap 12. With the absence of any metallic fastener within the coil construction, the use of the molded spool 20 of this invention practically eliminates any possibility of shorting the windings 21 and 22 against each other or against portions of the can 10. Finally, it will be seen that the leads 24, 25 and 26 are partially guarded by portions of the spool 20 and by the skirt 37 so that they cannot be moved by vibration into undesired contact with any other metallic portion in the construction.

Referring briefly to FIGS. 5 and 6, an alternate embodiment of the spool 20 is shown which is essentially similar to the preferred embodiment shown in FIG. 2, but in which the lowermost portion, instead of having radially-extending legs 41 and 42, has a pair of arcuate-shaped flanges 47 and 48 extending outwardly from the lower cylindrical portion of the spool 20, as indicated. The interior details of this embodiment of the spool 20 are the same, and the use and function are identical with those previously described. The diametrical distance between the outer edges of the flanges 47 and 48 is again substantially equal to the effective interior diameter of the can 10.

The coil spool 20 of this invention is conveniently molded from any plastic material which will have the sufficient mechanical strength to withstand the vibration encountered in automotive installations and which, of course, has satisfactory insulating characteristics. In addition, because the coils of the type described are generally filled with oil, the particular plastic used should not be absorbent with or reactive to the coil fluid, and should be able to withstand operating temperatures as high as 325° F. A preferred material has been found to be asbestos-filled nylon which is available from a number of commercial sources, such as Fiberfil Division, Dart Industries, Inc., Evansville, Ind. 47717. Other suitable molding materials having the desired characteristics will be apparent to those skilled in the art, and it is emphasized that the identity of the particular plastic material is not deemed to constitute a part of this invention.

It will be seen that through use of the coil spool described above, a number of advantages in manufacture and coil reliability over those produced in the prior art have been obtained. Various modifications to the preferred embodiment described above will be apparent to those skilled in the art and may be made without departing from the scope of the following claims.

We claim:

1. In an electric coil construction having primary and secondary windings positioned within a cylindrical coil can having a closed lower end and an open upper end with a coil cap secured thereto, the improvement comprising a unitary hollow spool having a cylindrical bore

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adapted to receive and support the secondary winding of said coil, a pair of axially-spaced-apart circular flanges extending around the outer surface of said spool, said flanges having a diameter slightly less than the diameter of the bore of said coil can whereby said spool may be slidably positioned in coaxial alignment therewith, and a spool-supporting foot extending axially below said spool and adapted to rest upon the closed lower end of said coil can to support said spool and said windings at a position coaxially intermediate the upper and lower ends of said coil can.

2. The electric coil construction of claim 1 wherein said coil spool further includes an annular rim extending above the uppermost circular flange and having an internal diameter adapted to snugly receive the lowermost portions of said coil cap to further secure said spool in coaxial alignment with said coil can.

3. The electric coil construction of claim 1 wherein said spool-supporting foot includes at least two opposed radial legs extending across the closed lower end of said coil can to support said spool within said can.

4. The electric coil construction of claim 3 wherein the total length of said opposed radial legs is substantially equal to the diameter of said coil can.

5. The electric coil construction of claim 1 wherein said spool-supporting foot comprises a hollow, frustoconical sleeve extending below the lowermost circular flange with a closed lower end.

6. The electric coil construction of claim 5 which further includes at least two opposed radial legs extending below said closed end of said frustoconical sleeve and across the closed lower end of said coil can to support said spool within said can.

7. The electric coil construction of claim 6 wherein the total length of said opposed radial legs is substantially equal to the diameter of said coil can.

8. A unitary molded plastic coil spool for positioning and supporting the primary and secondary windings of an electric coil within a cylindrical coil can having a

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closed lower end and an open upper end with a coil cap secured thereto, said spool comprising

a hollow cylindrical member,

a pair of axially-spaced-apart circular flanges extending around the outer surface of said cylindrical member to define a surface between said flanges for supporting the primary winding thereon, said flanges having a radial depth greater than the depth of said primary winding whereby the outer turns thereof are held in spaced relation from the adjacent interior surface of said coil can when said spool and primary winding are inserted therein,

a hollow sleeve extending below the lower circular flange and having a closed bottom, and

at least one radially-extending support leg below said closed bottom of said sleeve having a length substantially equal to the diameter of said coil can.

9. The coil spool of claim 8 wherein said hollow sleeve has a diameter less than the diameter of said hollow cylindrical member and is joined thereto by an annular land adapted to support said secondary winding within said hollow cylindrical member.

10. The coil spool of claim 8 wherein said hollow sleeve is a frustum with its smaller end adjacent said radially-extending support leg.

11. The coil spool of claim 8 which further includes an annular rim extending above the uppermost circular flange and having an internal diameter adapted to snugly receive the lowermost portions of said coil cap to further secure said spool in coaxial alignment with said coil can.

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