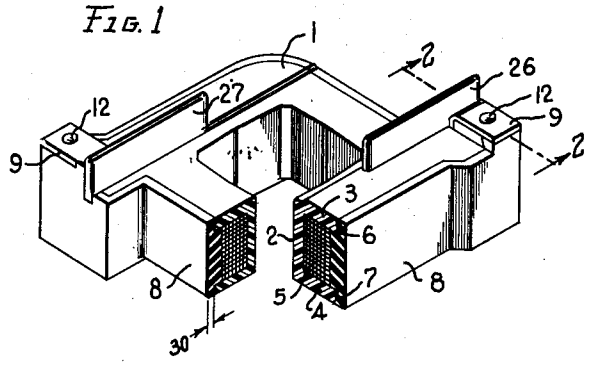
Feb. 5, 1963 J. HAMILTON ET AL 3,076,919

COIL FOR ELECTROMAGNETIC APPARATUS

Filed Feb. 21, 1958

FIG. 1



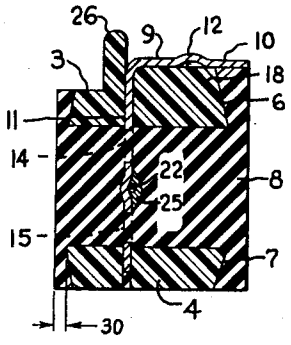


FIG. 2

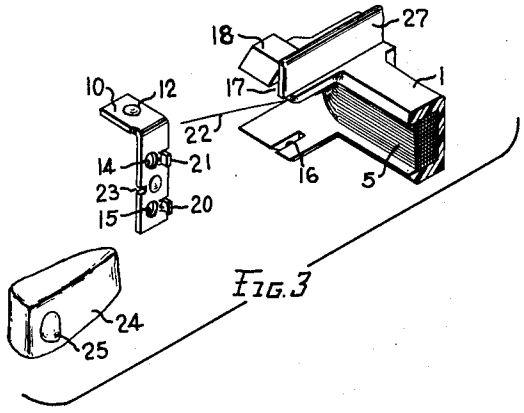


FIG. 3

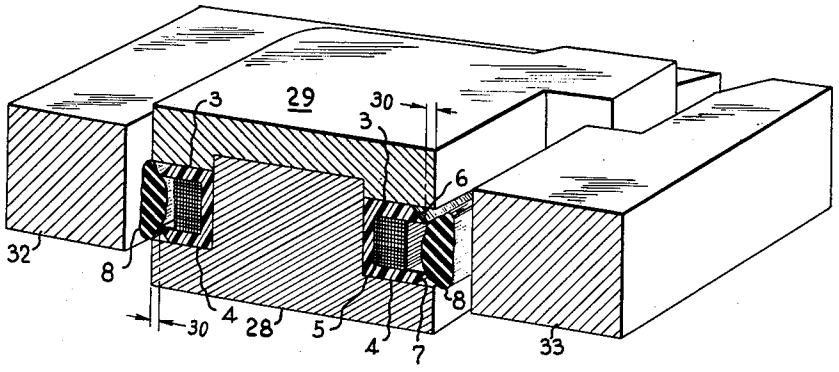


FIG. 4

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COIL FOR ELECTROMAGNETIC APPARATUS

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3 Claims. (Cl. 317—158)

This invention relates to improved coils for use with electromagnetic apparatus and is more specifically directed to the insulation and protection of such electrical coils.

The problem of insulating and protecting coils which are to be used with electromagnetic apparatus has been the subject of much development and research which have produced a wide variety of coil enclosures of varying utility and cost. Methods involving potting, casting, wrapping and encapsulation in general have been developed and the resulting coil structures have been acceptable for a narrow range of applications. However, these methods have suffered from one or more of the following deficiencies: Use of complex molding devices; use of high process temperatures and pressures; long process cycles; use of expensive constituent materials; short shelf life of constituent materials; use of hydroscopic materials such as paper for intermediate coil protection thereby requiring a coil enclosure sealed to the outer atmosphere; use of constituent material solvents which must be driven off before the coil can be enclosed; use of special end turns to facilitate coil connection.

Often the resulting coil structure is complex and mechanically weak and therefore not easily adaptable to the present day variety of coil applications. In addition, the unit cost of such coils has been a primary use limiting factor.

It is therefore an object of this invention to provide a totally enclosed operating coil for an electromagnetic device which is compact, rugged, dimensionally accurate, and exceptionally economical to manufacture.

It is a further object of this invention to provide a coil whose resulting enclosing structure has sufficient physical strength to enable the coil to perform a structural assembly function with its associated electromagnetic device.

It is an additional object of this invention to provide an operating coil of the class described in which the terminals, mounting features, and other appurtenances can be integrally molded therewith.

It is an object of this invention to provide a coil which can be attached to the associated electromagnetic device by the same means which establish connection to the coil terminals.

It is a further object of this invention to provide an operating coil having a bobbin on which the coil is wound and to which an outer insulating and protective jacket is easily and firmly attached by molding so as to provide a unitary construction.

It is a still further object to provide an enclosed coil having integral coil terminals to which the coil ends are soldered simultaneously with the coil enclosing operation.

In furtherance of these objects and in accordance with one aspect of our invention, we provide a coil assembly having a coil bobbin with a central column and first and second outwardly extending flanges between which a wire coil is placed. An outer jacket of insulating material encloses the coil filling the space between the flanges and the outer turns of said coil so that the jacket overlaps and laterally interlocks with the flanges to form a continuous mechanical bond with the outer edges of the flanges.

The copending application Serial No. 686,318, now Patent No. 2,924,685 entitled Magnetic Switch by James R. Burch and assigned to the present assignee is illustrative of an electromagnetic device that utilizes this improved coil.

For a full understanding of the nature and objects of the invention, reference should be had to the following detailed description taken in connection with the accompanying drawings, in which:

FIGURE 1 is a view of a completed coil having a portion of one corner removed;

FIGURE 2 is a cross section of the coil at the terminal taken along the line 2—2;

FIGURE 3 is an exploded view of the coil terminal construction; and

FIGURE 4 is a schematic representation of the coil molding process.

Illustrated in FIGURE 1 of the drawings is a coil insulated and protected by our improved process which has a bobbin 1, preferably an integrally molded piece having a central column 2, an upper flange 3 and a lower flange 4. The wire coil 5 is level wound on the bobbin 1 so that the desired number of turns does not fully occupy the space defined between the flanges 3 and 4 of the bobbin 1. The flanges 3 and 4 have their outer edges beveled at 6 and 7 so as to present a locking surface for the jacket 8 which extends completely around the periphery of the wire coil 5 and the bobbin 1 and substantially fills the space between the flanges 3 and 4. The jacket 8 is molded about the bobbin 1 and the wire coil 5 so that it has a portion overlapping the flanges 3 and 4 at the beveled edges 6 and 7 while being flush or even with the upper surface of the flange 3 and the lower surface of the flange 4.

In a preferred embodiment, the bobbin body 1 is compression molded from a general purpose phenolic resin and the jacket 8 is molded around the bobbin 1 from a rope or strip of glass filled alkyd resin, known as "Glaskyd." Both materials are low in cost, commercially available, and dimensionally stable. The phenolic bobbin 1 and the "Glaskyd" jacket 8 do not have any adhesive qualities but rather are retained in relative position as shown at the coil cross section of FIGURE 1 by the interlocking joint defined by the beveled flange edges 6 and 7 and the overlapping jacket 8. The "Glaskyd" jacket 8 has the physical characteristic of shrinking when molded thereby adding to the mechanical effectiveness of the interlocking bobbin-jacket relationship. This interlocking bond can extend completely around the coil so as to give maximum mechanical interlocking strength or a mechanical bond can be established at selected points about the coil periphery.

The wire coil is preferably formed from "Formex" wire and the insulation thereon is the only insulation added to the coil itself. By thus doing away with the necessity for paper or fiber insulation and liners for the spindle, all hygroscopic material is removed from within the coil. Therefore, the mechanical bond between the jacket 8 and the flanges 6 and 7 is a compression joint only allowing the coil to breath so as to establish a pressure equilibrium with the outside atmosphere.

FIGURES 2 and 3 illustrate the ease with which coil terminals can be integrally molded in the improved coil construction. The terminals 9 are identical and are generally L-shaped and have an upper contact surface 10 extending parallel to the upper flange 3 and a vertical portion 11 extending into the slots 16 and 17 in the flanges 3 and 4. Each upper surface 10 has a contact button or indentation 12 to facilitate the positioning of a contact relative to the terminal. The contact structure shown in the aforementioned copending application Serial No. 686,318 now Patent No. 2,924,685 entitled Magnetic Switch by James R. Burch is illustrative of the ease with which electrical connection is established with our improved coil. It further illustrates how the contact structure acts upon this improved coil to hold a switch assembly together.

The terminal shown in FIGURE 3, has apertures 14 and 15 formed therein and positioned on the terminal portion that extends between the flanges 3 and 4. Slots 16 and 17 are positioned in the flanges 3 and 4 so as to accept the terminal 9 and position it relative to the coil bobbin 1. The bobbin 1 has the raised portion 18 which supports the upper terminal portion 10 when the terminal is positioned in the slots. The tabs 20 and 21 can be positioned adjacent to the apertures 14 and 15 to further facilitate the positioning of the terminal.

As clearly seen in FIGURE 2, the jacket 8 extends through the apertures 14 and 15 so as to lock it firmly in place relative to the flanges 3 and 4. The jacket 8 also surrounds the projections 20 and 21 to further insure correct positioning and mechanical security of the terminal. As seen in FIGURE 3, the coil 5 has an end turn 22 which is brought out from the coil and wrapped into the slot 23 midway along the terminal upright portion. This slot serves to hold the coil end in position prior to the molding operation.

The coil turn is soldered to the terminal by placing a segment of high bismuth content (low melting point) solder either in the slot adjacent to the coil end turn or, as shown in FIGURE 3, on a piece 24 of the jacket which is then positioned between the flanges so as to trap the solder adjacent to the wire and terminal. When the jacket 8 is molded about the bobbin 1, the heat is such as to melt the solder 25 thereby establishing a firm electrical connection.

If it is desired, other appurtenances can be molded into the coil housing. For example, the barrier members 26 and 27 are molded adjacent to the terminals 9 and 13 so as to provide protection and insulation from the electromagnet armature material which would pass through the aperture defined by the bobbin 1.

Referring now to FIGURE 4, the coil bobbin 1 is shown positioned on the mold bottom 28 with the mold top 29 in position. It is seen that the mold top and bottom extend beyond the outer edge of the periphery of the flanges 3 and 4 by the amount 30 which is seen to be equal to the overlap distance 30 in FIGURE 1. The outer beveled edges 6 and 7 define chambers between the mold top 29 and mold bottom 28 into which the jacket 8 will be forced so as to effect the overlapping and interlocking joint with the coil flanges. To prepare the bobbin and coil for the molding operation, the terminals are placed into position and the solder trapped adjacent to the terminal as was previously described. The outer periphery of the coil and bobbin is then wrapped with a rope or band of resin as is shown in FIGURE 4. After the mold top 29 and mold bottom 28 have been placed in position relative to the bobbin 1, the mold sides are brought into contact with the mold top 29 and mold bottom 28 through the application of pressure and heat. The rope 8 is then displaced into intimate contact with the coil 5 and with the flanges 3 and 4 including the overlap portion at the beveled edges 6 and 7. Any extra material is forced out between the mating surfaces of the mold side members 32 and 33 and the mold top member 29 and bottom member 28. The Glaskyd resin has properties such that it is completely cured and in position after a molding time of about 45 seconds at a pressure of 1,000 lbs. per square inch and a temperature of 320° F. This mold time and temperature are sufficient to melt the solder so as to establish a firm joint between the coil end turns and the terminals.

It is therefore seen that we have provided a coil whose construction is extremely simple and economical, a coil which does not require a separate operation to establish the electrical connection between the coil ends and the terminals, and a coil whose terminals can be integrally molded with the coil during a single molding operation. We have further provided an insulating and protecting jacket for a coil which is held to the coil bobbin by a mechanical bond only so as to permit breathing and have provided a coil which does not contain the heretofore used hydroscopic materials within the insulated body.

It is obvious that certain changes can be made in practicing this invention without departing from the true spirt of this invention and it is therefore intended that the previous description should be considered illustrative only and that the true scope of the invention should be determined by the appended claims.

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

1. A coil assembly for electromagnetic apparatus comprising an insulating bobbin having a central column and a pair of radially extending axially spaced flanges, said flanges having outer edges beveled so as to form beveled surfaces extending from the inner confronting surfaces of the flanges inwardly toward the column to the outer surfaces of the flanges, a coil of insulated wire surrounding the column in the space between the flanges, said coil having a radial dimension substantially less than the radial dimension of the inner surfaces of the flanges, and a band of solid thermosetting insulating material which shrinks on setting filling the space between the inner surfaces of the flanges and in intimate contact with the periphery of the coil and said inner surfaces, said band extending radially beyond the edges of the flanges and extending axially at least to the outer surfaces of the flanges to overlap the beveled surfaces in intimate contact therewith.

2. A coil assembly for electromagnetic apparatus comprising an insulating bobbin having a central column and a pair of radially-extending axially spaced flanges, said flanges having outer edges beveled so as to form beveled surfaces extending from the inner confronting surfaces of the flanges inwardly toward the column to the outer surfaces of the flanges, a coil of insulated wire surrounding the column in the space between the flanges, said coil having a radial dimension substantially less than the radial dimension of the inner surfaces of the flanges, one of said flanges having spaced slots extending radially from the edge thereof toward the coil, a pair of generally L-shaped terminals each having one leg projecting axially into a separate slot of the one flange and having the other leg exposed to receive a contact, the ends of said coil being connected to said terminals, and a band of solid thermosetting insulating material which shrinks on setting filling the space between the inner surfaces of the flanges and in intimate contact with the periphery of the coil and said inner surfaces, said band extending radially beyond the edges of the flanges and extending at least to the outer surfaces of the flanges to overlap the beveled surfaces in intimate contact therewith.

3. A coil assembly for electromagnetic apparatus comprising an insulating bobbin having a central column and a pair of radially-extending axially spaced flanges, said flanges having outer edges beveled so as to form beveled surfaces extending from the inner confronting surfaces of the flanges inwardly toward the column to the outer surfaces of the flanges, a coil of insulated wire surrounding the column in the space between the flanges, said coil having a radial dimension substantially less than the radial dimension of the inner surfaces of the flanges, one of said flanges having spaced slots extending radially from the edge thereof toward the coil, a pair of L-shaped terminals each having one leg projecting axially into a separate slot of the one flange and having the other leg overlying the other flange and exposed to receive a contact the ends of said coil being connected to the one leg of said terminals, and a band of solid thermosetting insulating material which shrinks on setting filling the space between the inner surfaces of the flanges and in intimate contact with the periphery of the coil and said inner surfaces, said band extending radially beyond the edges of the flanges and extending at least to the outer surfaces of the flanges to overlap the beveled

surfaces in intimate contact therewith, said band completely impeding the one legs of said terminals.

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