One embodiment of the present invention involves a lead-in attachment for attaching lead-in wires to a coil wound on a bobbin. The attachment includes an elongated terminal which has a pair of feet formed thereon at one end thereof. The feet are so proportioned as to grip the inside of a recess in the flange of a bobbin for mounting the attachment securely on the bobbin. The terminal has a projection integral therewith and projecting into a punched out rectangular portion in the center of the terminal. The terminal is formed at its other end with a pair of oppositely and sidewardly extending projections which are curved about an axis to define a part-cylindrical shape adapted to receive a lead to be crimped to the terminal. The full nature of the invention will be understood from the accompanying drawings and the following description and claims.

FIGS. 1 through 5 are perspective views of a coil arrangement showing in serial fashion the steps of the process embodying the present invention.

FIG. 6 is a plan view of a lead-in attachment means embodying the present invention.

FIG. 7 is a view similar to FIG. 6 but showing the attachment means in completed form.

FIG. 8 is a side elevation of the structure illustrated in FIG. 7.

FIG. 9 is a section taken perpendicularly to the axis of the coil of FIG. 3 and through one of the flanges thereof.

FIG. 10 is a fragmentary view taken along the line 10—10 of FIG. 9 in the direction of the arrows.

FIGS. 11, 12 and 13 are perspective views of alternative lead-in attachment means embodying the present invention.

For the purposes of promoting an understanding of the principles of the invention, reference will now be made to the embodiment illustrated in the drawings and specific language will be used to describe the same. It will nevertheless be understood that no limitation of the scope of the invention is thereby intended, such alterations and further modifications in the illustrated device, and such further applications of the principles of the invention as may be contemplated by those skilled in the art to which the invention relates. Referring now more particularly to the drawings, there is illustrated a bobbin 10 of electrical insulating material such as epoxy resin having a core opening 11 thereof and provided with flanges 12 and 15. The flange 15 has a circular shape while the flange 12 is provided with a pair of terminal slots 16 and 17 as well as a start wire slot 20. The terminal slots 16 and 17 are generally rectangular in shape as shown in FIG. 9 while the start wire slot 20 opens from the inside of the flange 12 at the winding surface 21 and tapers radially at 22 toward the terminal slot 16 until it opens at the periphery 25 of the flange adjacent the terminal slot 16.

FIGS. 6, 7 and 8 show in detail a representative one of the terminals 26 of the present invention. In FIG. 6 the terminal is shown just after stamping out and prior to any further forming operations. The terminal includes a pair of feet 27 which project from one end 28 of the terminal in a longitudinal direction and which have gripping or clawing surfaces 30 facing toward the opposite end 31 of the terminal. Centrally of the terminal 26 is a generally rectangular punched out portion 32 which defines a central projection 35 having an enlarged head 36. At the end 31 of the terminal there are provided two oppositely and sidewardly extending projections 37 which are curved as shown in FIG. 7 to form a part-cylindrical shape.

The process of the present invention has as an initial step the insertion of two of the terminals 26 into the rectangular recesses 16 and 17. Prior to insertion of the terminals, the projections 35 are bent so that they project...
outwardly as illustrated in FIGS. 1, 2 and 3. The end 28 of the respective terminals is so sized slightly larger than the dimension of the recesses 16 and 17 that the legs 40 carrying the feet 27 are biased inwardly by the surface of the recesses 16 and 17. The relatively smaller dimension of the recesses 16 and 17 causes the feet 27 to force the relatively soft insulating material making up the bobbin and causes the surfaces 30 to engage the material and to firmly mount the terminals in the flange. FIG. 2 shows the result of the next step of the process which is the winding of the coil 50 on the bobbin so that the start wire 51 is received in the first wound portion 26 and the finish wire 52 extends from the external surface of the coil 50. The start wire and the finish wire are then connected to the terminals 26 by winding of the respective wires on the respective projections 35 and dipping of the projections 35 in a solder bath. Such winding of the coil 50 and soldered attachment of the start wire and finish wire to the respective projections 35 can be accomplished by automatic conventional presently available apparatus. Referring to FIG. 3, the next step of the present process is the insertion of lead wires 55 having bared ends 56 into the curled portion 31 of the respective terminals 26. The curled portions 31 are then formed about the conductor or bare end portions 56 of the insulated lead-in wires 55 to firmly secure the lead-in wires to the terminals 26. The next step of the process is illustrated in FIG. 4, where the terminals are bent down against the winding 50 so that the terminals extend axially of the bobbin 10. It will also be noted that the projections 35 are bent down against the bobbin and also extend axially thereof. The next step of the process involves the encapsulation of the structure illustrated in FIG. 4 in such a manner that the lead-in wires 55 project from the final encapsulated structure 57. It has been found that the method and means of the present invention substantially reduces the labor costs involved in manufacturing an encapsulated coil. Furthermore, the direct mechanical connection of the lead-in wires to the bobbin through the terminals 26 provides substantial mechanical strength to the lead connection which is not dependent upon the encapsulation of the coil. The mechanical connection of the lead wires to the bobbin flange not only permits relative close spacing of the lead connections so that there is only a minimum change in the final encapsulated shape of the coil but also prevents any movement of the lead wires during the encapsulation procedure. It should be noted that the various steps illustrated in FIGS. 1 through 5 can be accomplished by manual operations. Even so, the present invention is particularly adapted to automation. This is true because the terminal is provided with a soldering ear or projection 35 permitting machine soldering and because the curled portion or eyelet 31 permits mechanical feeding of the lead wire into the eyelet and crimping thereof. It has also been found that the coil arrangement of the present invention makes more desirable the use of the start wire slot feature disclosed in the above mentioned Howenstein patent.

Referring to FIGS. 11, 12 and 13, the lead-in attachment means illustrated therein are identical to the lead-in attachment means of FIGS. 6, 7 and 8 except that the oppositely and sidewardly extending projections 37 are replaced by certain other structure intended for securing the respective lead-in attachment means to a lead wire which has not had the insulation removed from the end thereof. In the embodiment of FIG. 11, the end portion 31' of the terminal has oppositely extending projections 37' which are formed into a rectangular configuration. The end portion 31' is also punched out to define a pointed projection 100. The embodiment of FIG. 11 is used similarly to the embodiment of FIGS. 6, 7 and 8 except that the lead wire end portion about which the arms 37' are cramped is insulated and not bared or cleaned and the projection 100 penetrates the insulation to provide the electrical connection. The embodiment of FIG. 12 is identical to the embodiment of FIG. 11 and is used in the same way except for the location of the pointed projection 101. As illustrated, the projection 101 is formed on the edge of the end portion 31" instead of punched in the end portion as in FIG. 11. The embodiment of FIG. 13 is identical to the embodiments of FIGS. 11 and 12 except that a pair of projections 102 are provided in place of the projection 100 and the projection 101. The projections 102 are formed on the lead wire slot 75 and the projection arms 105. The embodiment of FIG. 13 is used similarly to the embodiments of FIGS. 11 and 12 in that the end portion 31" is cramped around the insulated end portion of a lead-in wire. During such crimping the projections 102 pierce the insulation to make electrical contact with the conductor in the lead-in wire. It should be noted that each of the terminals of FIGS. 6--8, 11, 12 and 13 permits a mechanical connection to the lead-in wire and eliminates the necessity of soldering the lead-in wire to the terminal.

While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character, it being understood that only the preferred embodiment has been shown and described and that all changes and modifications that come within the spirit of the invention and the scope of the claims are also desired to be protected.

The invention claimed is:

1. Lead-in attachment means comprising an elongated terminal having a pair of feet formed thereon at one end thereof, said feet projecting axially of said terminal from the one end thereof and having a pair of claws which face toward the other end of said terminals, a projection integral with said terminal and projecting into a punched out rectangular portion in the center of said terminal, said terminal being formed at its other end with a curled portion comprising a pair of oppositely and sidewardly extending projections which are curved about an axis to define a part cylindrical shape adapted to receive a lead for crimping the terminal about the lead.

2. A method of making a coil comprising inserting a pair of terminals in the flange of a bobbin, winding a coil on the bobbin to provide a start wire and a finish wire, winding the start wire on a projection integral with one of said terminals, winding the finish wire on a projection integral with the other of said terminals, dipping said projections in solder, inserting the bare end of an insulated lead wire in a curled portion at the distal end of one of said terminals, inserting the bare end of another insulated lead wire in another curled portion at the distal end of the other of said terminals, crimping said curled portions about said lead wires, bending said terminals and projections over against said coil, and encapsulating said coil and terminals and the connections of said terminals and lead wires whereby said lead wires extend from the encapsulated coil.

3. A coil arrangement comprising a bobbin, a coil of wire wound on said bobbin, a terminal mounted on said bobbin, said terminal being centrally punched out to define a projection, the end of said coil wire being wound on and soldered to said projection, an insulated lead wire having a bared end received within said terminal, said terminal being cramped and secured, and encapsulation surrounding said coil and terminal and the connection of said terminal and said lead wire.

4. A coil arrangement comprising a bobbin having a pair of flanges at the opposite ends thereof, a coil wound on said bobbin to provide a start wire and a finish wire, one of said bobbin flanges having a pair of terminal slots therein and a start wire slot therein, a pair of terminals each received in a respective one of said terminal slots, said start wire extending through said start wire slot and being connected to one of said terminals, said finish wire
being connected to the other of said terminals, a curled portion at the distal end of each of said terminals, a pair of lead wires with bared ends each received within a respective one of said curled portions, said curled portions being crimped about the bared ends of said lead wires, and encapsulation surrounding said coil and terminals and the connection of said terminals and said lead wires.

5. A coil arrangement comprising a bobbin having a pair of flanges at the opposite ends thereof, a coil wound on said bobbin to provide a start wire and a finish wire, one of said bobbin flanges having a pair of terminal slots therein and a start wire slot therein, a pair of terminals each received in a respective one of said terminal slots, each of said terminals being centrally punched out to define a projection, said start wire extending through said start wire slot and being wound on and soldered to one of said projections, said finish wire being wound on and soldered to the other of said projections, a curled portion at the distal end of each of said terminals, and a pair of lead wires with bared ends each received within a respective one of said curled portions, said curled portions being crimped about the bared ends of said lead wires, said terminals and projections being bent down against said coil so as to extend axially of said coil.

6. A coil arrangement comprising a bobbin having a pair of flanges at the opposite ends thereof, a coil wound on said bobbin to provide a start wire and a finish wire, one of said bobbin flanges having a pair of terminal slots therein and a start wire slot therein, a pair of terminals each received in a respective one of said terminal slots, each of said terminals being centrally punched out to define a projection, said start wire extending through said start wire slot and being wound on and soldered to the other of said projections, a curled portion at the distal end of each of said terminals, a pair of lead wires with bared ends each received within a respective one of said curled portions, said curled portions being crimped about the bared ends of said lead wires, said terminals and projections being bent down against said coil so as to extend axially of said coil, and encapsulation surrounding said coil and terminals and the connection of said terminals and said lead wires.

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