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COIL AND SUPPORT CONSTRUCTION

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This invention relates to coil and support constructions, and particularly to improvements in such constructions adapted for use with small coils, such as may be used in microphones.

In small coil structures, accuracy and uniformity of dimensions are highly important because the requirements for fitting together with other small parts are quite exacting. Bobbins for small coils have been constructed heretofore by fitting side members or flanges over the ends of a hollow tube of electrical insulating material and turning the edges of the tube over to form beads to hold the flanges in place. Such construction has the disadvantage that inaccuracy and non-uniformity of dimensions are practically unavoidable. Another method of constructing bobbins is by molding sections, such as halves, of plastic molding composition, and placing the sections together. This has the disadvantage of being expensive and capable of only medium accuracy and uniformity of dimensions because of the shrinking and warping which is unavoidable during cooling of small sections after molding. It has the further disadvantage that reinforcements, such as linen inserts, which are desirable in small bobbins, cannot be used.

It is the object of the present invention to provide a bobbin for small coils which is capable of a high degree of accuracy and uniformity of dimensions.

It is a further object of the invention to provide a bobbin for small coils which is simple and inexpensive both in structure and manufacture, and is strong and durable.

The invention is illustrated by means of the specific embodiments shown in the accompanying drawing, in which Fig. 1 is drawn to actual scale and the remainder of the figures are enlarged. In the drawing:

Fig. 1 is a sectional view of a coil and bobbin construction in accordance with the invention, taken along line 1-1 of Fig. 2;

Figs. 2 and 3 are top and side views respectively of the coil and bobbin construction;

Figs. 4 and 5 are plan and edge views, respectively of a side member of the bobbin;

Figs. 6 and 7 are plan and edge views, respectively, of a top or bottom member;

Figs. 8 and 9 are top plan views of the bobbin in different stages of the assembly thereof;

Fig. 10 is an isometric view of the bobbin in the assembled condition;

Fig. 11 is a phantom view of a different modification of the bobbin of the invention;

Fig. 12 is a plan view of an end member of the bobbin of Fig. 11;

Figs. 13 and 14 are views illustrating a method of assembling the bobbin of Fig. 11;

Fig. 15 is a plan view of a side member of a further modification of the invention and;

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Fig. 16 is a side view of a pair of assembled top and bottom members adapted to be used with the side member shown in Fig. 15.

Fig. 1 is shown in actual size to convey an idea of the extreme small size of the coil and bobbin construction and of the difficulties involved in constructing a coil and insulating bobbin structure which is accurate and uniform in dimensions and at the same time possesses strength and rigidity.

The structure of Figs. 1, 2 and 3 comprises a winding or coil 10 of small gauge insulated wire wound upon top and bottom members 11 and 12 and between side members 13 and 14. The top and bottom members 11 and 12 are spaced apart and the entire construction is such as to form an opening 15 in the middle of the coil. The structure is adapted to be associated with a ferromagnetic core (not shown), a leg of which passes through the opening 15.

The top and bottom members, which, for brevity, will be called the supporting members, and the side members are composed of hard, relatively stiff electrical insulating sheet material, such as hard rubber, pressed fiber, woven fiber such as linen, impregnated with a hardening substance such as phenol-formaldehyde resin or other resin, etc. They are formed out of such sheet material by a stamping operation whereby their shape and dimensions are quite accurate and uniform. Both of the side members are of identical form and the supporting members are likewise. The side members, as shown in Fig. 4, are generally rectangular in shape and somewhat greater in length than in width. Each has a generally rectangular opening 20 of substantially greater length than width therein, said opening having narrow elongations, or slots 21, 22, 23 and 24 extending longitudinally from the corners thereof and having a width substantially equal to the thickness of the supporting members. As a result, there are longitudinally inwardly extending projections 25 and 26 of the material between each pair of slots. At points spaced outwardly from opening 20 and located adjacent to the corners are two openings 30 and 31. A third opening 32 is located at an edge of opening 20 and connects with opening 20. Openings 30, 31 and 32 are all located on the same side of opening 20, although they may be located on different sides, as will be apparent from the following description.

The top member 11, illustrated in Figs. 6 and 7, is also of a generally rectangular shape, comprising a middle portion 33 and side portions widening from the middle portion in stepped sections 34 and 36 at one side and 35 and 37 at the other. Outwardly opening slots 38 and 39 are formed in the side sections, respectively, but for the purposes of the present invention may be ignored,

since they are merely for the purpose of fitting the coil structure together with the remainder of the device with which it is used. The middle portion 33 has a length (vertical dimension as seen in Fig. 6) substantially equal to the distance apart of the ends of projections 25 and 26 of side member 14. Said middle portion 33 has a width (dimension from step section 34 to step section 35) substantially equal to the desired width of coil (see Figs. 2 and 9). Step sections 34 and 35 have a length 10 substantially equal to the length of the opening 20 between the ends of slots 23 and 24, and a width substantially equal to the thickness of the side members. Side sections 36 and 37 have a length substantially greater than that of step sections 34 and 35.

The supporting members and side members are adapted to be fitted together in the manner illustrated in Figs. 8 and 9 to form a final construction best shown in Fig. 10. The two side members are first placed together with their flat surfaces in abutting relation and corresponding parts in registry. The side portion of one of the supporting members is then inserted edgewise into one of the pairs of aligned slots of the opening 20, for example, the slots 23 and 24. The supporting member is turned so that its transverse axis is at an angle to the planes of the side members, as shown in Fig. 8, and the entire side portion is passed through the slots of both side members. This is possible because the length of the side portions 26 and 27 is so limited that the distance between one edge of the middle portion 33 and the opposite edge of a side portion is slightly less than the extreme length of opening 20, i. e., the length of the main portion of opening 20 plus the two aligned slots 23 and 24. A side portion of the second supporting member is then similarly passed through slots 21 and 22 and the main portion of opening 20. After this has been done, the supporting members are turned so that their transverse axes and their planes are substantially perpendicular to the planes of the side members 13 and 14, and the side members are moved apart and into their final positions, as shown in Figs. 9 and 10. In this position, each pair of aligned slots fits upon one of the intermediate step sections 34 and 35 of a supporting member, and the interior edges of the side sections 36 and 37 engage the exterior surfaces of the side members 13 and 14 and hold said members against moving apart more than a predetermined distance. The assembly is held in such position that the planes of the side members are perpendicular to the planes of the supporting members to form a parallelepiped, as is best shown in Fig. 10.

For winding the coil, a jig member (not shown) which may be simply a bar of rectangular shape in cross section and adapted to fit snugly into the opening 15 of the bobbin (see Fig. 3), is inserted into the said opening 15. The jig member causes the step sections 34 and 35 to exert pressure upon the cooperating edges of the side members whereby the latter are held in position. One end portion 45 of a strand of wire is then passed outwardly through opening 32 and the bobbin is rotated by means of the jig member or otherwise and the strand of wire is wound upon the supporting members 11 and 12 and between the side members 13 and 14 to form the coil 16. The outer end portion 46 of the strand is then passed through opening 30, where it is available for connection to the external circuit. The inner end portion 45 of the strand which projects from opening 32 is also available for connection to ex-

ternal circuit. This end portion may be passed through the opening 31 if desired.

After the wire has been wound in place, the coil itself holds the side members firmly against the interior edges of the side portions 36 and 37 of the supporting members. The step sections 34 and 35 of the supporting members engage the ends of the slots 21, 22, 23 and 24 of the side members and prevent said members from undergoing any relative movement in a longitudinal direction. As a result, a strong, rigid and durable coil and supporting structure are formed. Although the bobbin members may be made of very thin sheet material, having a thickness, for example, of approximately .015 inch, they possess sufficient stiffness in the very small sizes involved that the entire structure is substantially rigid against all of the handling and usage to which they are subjected. The parts can be stamped out with a high degree of dimensional accuracy with precision dies, and all dimensions can be kept within tolerances of less than .005 inch. As a result, the parts can be assembled quickly and the completed coil and supporting structure are firm and rigid and its dimensions are accurate and uniform. The latter factor is of great importance in the small devices with which the coils are used. In addition, the cost of the bobbin is but a fraction of the cost of a molded bobbin for the same purpose.

The modification of the bobbin structure illustrated in Fig. 11 is substantially similar to that which has been described heretofore, with the difference that it is supplied with end members extending between the supporting members. The bobbin comprises the two side members 43 and 44 and the two supporting members 45 and 46 which are constructed and arranged in a manner substantially similar to that employed in the device of Figs. 1, 2 and 3. Sheet form end members 47 and 48, which may be composed of material similar to that of the other members, are arranged to cover the end edges of the supporting members and the spaces between said members. The end members are substantially rectangular in shape, as shown in Fig. 12, and have short end portions slightly narrower than the main portion. The main portion is of a width sufficient to extend between the supporting members and cover the edges thereof, and the end portions are of a width such that they fit between the supporting members. The end portions are formed by narrowing the member on each side by an amount equal to the thickness of the supporting members. In this arrangement, if it is desired to provide a core opening of substantially the same size as opening 15 of the construction of Figs. 1, 2 and 3, the inwardly projecting portions of the side members corresponding to the portions 25 and 26 shown in Fig. 4 are made shorter than in the device of Figs. 1, 2 and 3 by an amount sufficient to accommodate the end members, i. e., an amount equal to the thickness of the end members.

In the device of Fig. 11, the assembly of the side members and supporting members is the same as has been described heretofore in connection with the device of Figs. 1, 2 and 3. A suitable method for inserting the end members 47 and 48 is by grasping the end member between the jaws of a blunt-nosed pliers 50, as illustrated in Figs. 13 and 14, the interior surfaces of the jaws being curved so as to place a curve in the end member

47 and shorten its projected length. The material of the end member should possess resilient flexibility such that it bends under moderate pressure and returns to its flat condition when the pressure is released. One end of the end member is then inserted into the opening of one of the side members, between the edges of the supporting members and the end of one of the projections corresponding to the projections 24 and 25. The curvature of the end member should be sufficient that the other end thereof does not quite reach the interior surface of the other side member. Said other end is then partially inserted in the opening of the other side member in a position corresponding to that of the first end. The end member is thus held in position sufficiently to permit removal of the pliers 50 and the pliers may be disengaged from the end member and withdrawn, whereupon the end member will flatten and assume its proper position as shown in Fig. 11. The other end member 48 may be inserted in the same manner.

The construction of Fig. 11 provides greater supporting surface for the interior turns of the wire of the coil, and protects the interior of the coil from contacts which it may otherwise receive in handling or use.

The modification which is illustrated in un-assembled condition in Figs. 15 and 16 is adapted for use with an air core rather than a ferromagnetic core, that is, where a ferromagnetic core does not thread the coil. In this modification, the side member, as illustrated by the member 53 of Fig. 15, does not have a central opening corresponding to opening 20 of side member 14 (see Fig. 4), but has a pair of spaced apart parallel slots 54 and 55 extending longitudinally thereof. The supporting members 56 and 57 are of the same form as is supporting member 11 of Fig. 6, and are joined together in spaced apart parallel relation corresponding to the relation of slots 54 and 55. The means for joining the said supporting members is a block 58, which may be composed of wood, molded resin, hard rubber, or other suitable electrical insulating material, and may be attached to the supporting members by an adhesive or other suitable means. The side members and supporting members may be assembled in a manner similar to that described heretofore in connection with Figs. 8 and 9, with the difference that a single side member is slipped over the side portions of both of the assembled supporting members simultaneously, and then the other side member is similarly slipped over the opposite side portions of the assembled supporting members.

As an alternative, the block 58 may be composed of compressed powdered ferromagnetic metal to provide a short ferromagnetic core. Such construction is especially adapted for use in high frequency apparatus.

All of the modifications which have been described possess the advantage that they are simple in construction and low in cost and still possess the primary properties of high accuracy and uniformity of dimensions and adequate strength, rigidity and durability.

While but a few embodiments of the invention have been illustrated and described, it is understood that these are illustrative only of the invention and that various further changes and modifications may be made without departing from the invention as the same is set forth in the appended claims.

What is claimed is:

1. A coil and support therefor, consisting of a pair of sheet form side members and a pair of flat sheet form supporting members, said side members interfitting with said supporting members to form a general parallelepiped with said side members forming flanges extending beyond the surfaces of the supporting members and being limited by said supporting members against movement apart beyond a predetermined distance, and a coil of strand material wound upon said supporting members and holding said side members against movement toward each other.

2. A bobbin for coils, comprising a pair of spaced apart, generally parallel, sheet form side members each having at least one opening therein, and a pair of sheet form supporting members extending through said openings in said side members, said openings being so shaped as to hold said supporting members in spaced apart, generally parallel relation, the portions of said supporting members resting within said openings having a length substantially equal to the length of the cooperating portions of said openings, the portions of said supporting members extending exteriorly of said side members and between said side members being respectively longer and shorter than said first mentioned portions.

3. A bobbin for coils, comprising a pair of spaced apart sheet form side members each having at least one opening therein, a pair of sheet form coil supporting members extending between said side members and through said openings, said openings being so shaped as to hold said supporting members in spaced apart, generally parallel relationship, each portion of the supporting members lying within an opening having a length substantially equal to the length of the cooperating portion of the opening, the portions of the supporting members lying between said side members having a length substantially less than said opening length, and the portions of said supporting members extending beyond said side members having a length substantially greater than said opening length, whereby a supporting member may be passed through an opening in a side member by turning said supporting member so that the transverse axis thereof is at an angle to the plane of said side member.

4. A bobbin construction as claimed in claim 3, in which sheet form end members extend between the ends of the portions of the supporting members lying between the side members to enclose the space between said supporting members.

5. A bobbin construction as claimed in claim 3, in which sheet form end members cover the edges of and extend between the portions of the supporting members extending between the side members, the openings in the side members being so shaped as to cooperate with said edges of the supporting members to hold said end members in position.

6. A bobbin for coils, comprising a pair of spaced apart sheet form side members each having at least one opening therein having the opposite end portions thereof in the form of a pair of generally parallel slots, and a pair of spaced apart sheet form coil supporting members extending between said side members and through said openings, said supporting members having their opposite side portions resting in said slots, the portions of said supporting members resting within said slots having a length substantially equal to the distance between the remote ends of said slots and a thickness substantially equal

to the width of said slots, the portions of said supporting members lying between said side members having a length substantially less than the length of said first mentioned portions and the portions of said supporting members lying outside of said side members having a length substantially greater than the length of said first mentioned portions.

7. A bobbin for coils, comprising a pair of spaced apart sheet form side members each having at least one opening therein having the opposite end portions thereof in the form of two generally parallel spaced apart slots, and a pair of sheet form coil supporting members extending through said openings to form with said side members an approximate parallelepiped, said coil supporting members having their opposite side portions resting in said slots and being of stepped configuration, the portions of said supporting members resting within said slots being of a length substantially equal to the distance between the remote ends of the cooperating slots, the portions of said supporting members extending between said side members being of a length substantially less than the length of said first mentioned portions thereof, and the portions of said supporting members exteriorly of said side members being of a length substantially greater than the length of said first mentioned portions thereof, whereby an end portion of a supporting member may be passed through a slot of a side member by turning said supporting member so that the transverse axis thereof is at an angle to the plane of said side member.

8. A bobbin for coils, comprising a pair of spaced apart, generally parallel, sheet form side members each having an opening therein, said opening having a main portion and a plurality of slot-shaped elongations extending from said main portion, and a pair of spaced apart, generally parallel, sheet form supporting members extending through said openings and held in position by said elongations, said supporting members, at the portions thereof resting within said openings, having a length substantially equal to the length of said openings at said elongations, the side portions of said supporting members arranged exteriorly of said side members having a length substantially greater than that of said first mentioned portions and the portions of said supporting members lying between said side members having a length substantially less than that of said first mentioned portions, whereby a side portion of a supporting member may be passed through said opening by turning said supporting member so that the transverse axis thereof is at an angle to the plane of said side member.

9. A bobbin for coils, comprising a pair of spaced apart sheet form side members each having an opening therein and two pairs of slots extending longitudinally from said opening, the slots of each pair being in substantial alignment with one another and the slots of one pair being generally parallel to those of the other, and a pair of sheet-form supporting members extending between said side members and through said slots, each said supporting member having a section resting within the slots of a pair of slots and having a length substantially equal to the distance between the remote ends of said slots and a width substantially equal to the thickness of said side members, said supporting members each having a second section lying between said side

members and being of a length substantially less than that of said first mentioned section, and a third section lying exteriorly of said side members and having a length substantially greater than that of said first mentioned section.

10. A bobbin for coils, comprising a pair of spaced apart sheet form side members each having two generally parallel spaced apart slots therein, and a pair of sheet form coil supporting members extending through said slots to form with said side members an approximate parallelepiped, said coil supporting members being of stepped configuration, the portions thereof lying within said slots being of a length substantially equal to the length of said slots, the portions thereof lying between said side members being of a length substantially less than the length of said slots and the portions thereof lying exteriorly of said side members being of a length substantially greater than the length of said slots, whereby an end portion of a supporting member may be passed through a slot of a side member by turning said supporting member so that the transverse axis thereof is at an angle to the plane of said side member.

11. A bobbin construction as claimed in claim 10, in which a portion of the material between the slots of each side member is removed to form an opening adapted to accommodate a core.

12. A bobbin construction as claimed in claim 10, in which means are provided independent of the side members for joining the supporting members together in spaced apart, generally parallel relation.

13. A bobbin for coils, comprising a pair of spaced apart, generally parallel, sheet form side members each having a pair of spaced apart generally parallel slots therein, and a pair of sheet form coil supporting members extending through said slots, each portion of said supporting members lying within a slot being of a length substantially equal to the length of said slot, each portion of said supporting members projecting beyond said side members being of a length substantially greater than the length of the adjacent slot and resting against the surface of the adjacent side member, and the portion of each of said supporting members lying between said side members and immediately adjacent to one side member having a length substantially less than the length of the adjacent slot, whereby an end portion of a supporting member may be passed through a slot of a side member by turning said supporting member so that the transverse axis thereof is at an angle to the plane of said side member.

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