

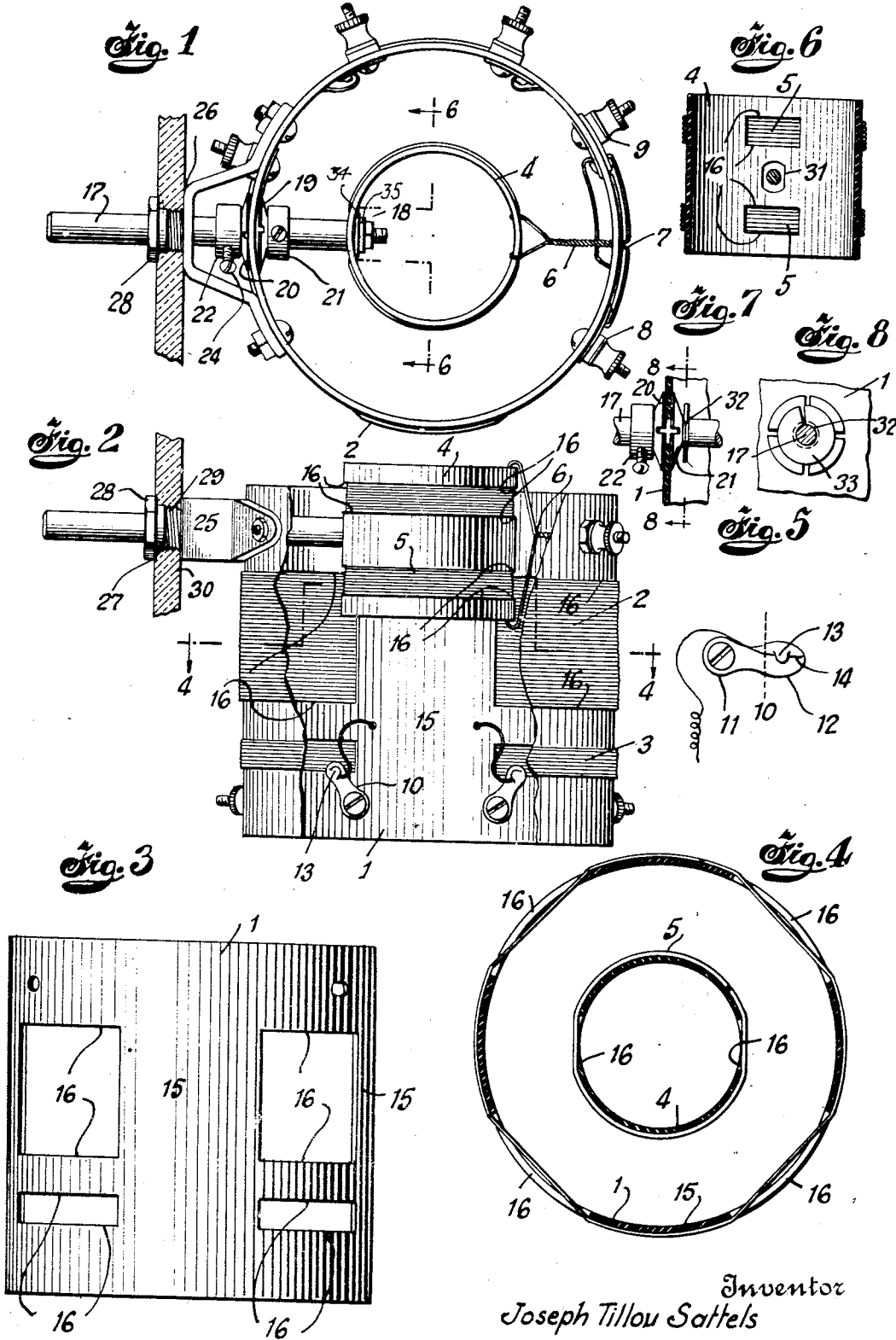
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J. T. SATTELS

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VARIABLE ELECTRICAL COIL

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Inventor
Joseph Tillou Sattels
By Attorney
Bohleber and Keltner

UNITED STATES PATENT OFFICE.

JOSEPH TILLOU SATTELS, OF PLAINFIELD, NEW JERSEY, ASSIGNOR TO DREADNOUGHT ELECTRIC CORPORATION, OF NEW YORK, N. Y., A CORPORATION OF NEW JERSEY.

VARIABLE ELECTRICAL COIL.

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This invention relates to variable electrical coils and more particularly to the type commonly used in radio receivers and consisting of a plurality of windings variably coupled one to another.

It is an object of this invention to produce a coil of the class described which is well adapted for production in large quantities at a relatively low cost.

It is a further object of this invention to produce such a coil which may be mounted upon a panel or other support by drilling only one hole therein, or in other words to provide a coil having what is known as a "single hole mount", in which wastage of material and unnecessary labor in forming and attaching the mount are minimized.

It is a further object of this invention to provide a coil of the class described in which the windings are supported and maintained in position by a method which is at the same time reliable and inexpensive and avoids certain disadvantages of the prior art.

It is a further object of this invention to produce a coil of the class described which shall be as inexpensive as possible without sacrifice of electrical or mechanical efficiency.

In the manufacture of coils of the class described in the past it has been the practice to support the windings of the coil from the core at as few points on the circumference of the winding as possible, in order to decrease the electrical losses in the supporting member. The core members used for such coils, termed "low loss" coils, were most usually made by being molded into final form from the material commonly known as "bakelite" and similar materials, and each core member was molded individually. Individual workmanship was therefore required which necessarily considerably increased the cost of the finished coil.

I have found that in making coils according to my invention, individual workmanship on each coil may be reduced very considerably, and coils may be produced in quantities at a considerably smaller cost per coil than heretofore. In accordance with my invention I utilize hollow cylindrical tubing which may be molded in lengths as great as commercially practical and thereafter cut to the proper or desired length. I may then punch or cut away portions of this tubing,

leaving axially extending portions which support the windings, and leaving also circumferentially extending edges to prevent the windings from slipping and prevent the turns from spreading.

Windings made according to the prior art are apt to be loose upon the forms and generally cannot be depended upon to remain in position without additional securing means. In the past such windings have been secured in position by the use of coil varnish and the like, or by projecting portions of special shape, designed to secure the windings in position, and molded on the core, but these methods are undesirable for the reason that they introduce additional losses in the coil and increase the distributed capacity of the windings, in the former case, and increase the cost of the coils in the latter.

I have found that it is possible to produce a coil whose windings are held in position by the portions remaining when parts of the core are cut away and which is sufficiently tightly wound upon a core to maintain its own position with no additional support, if the winding is wound upon a core as will be described later and particularly if the wire to be wound is first heated so as to cause it to expand appreciably and is then wound on the core with the maximum practical tension while hot and expanded. The contraction of the wire resulting from its cooling to normal temperature causes the winding to grip the core very tightly and resist displacement to a much greater degree than windings made at ordinary temperatures, while the circumferentially extending edges between which the winding lies, prevent any tendency of the turns to spread apart.

Furthermore, the "single hole mounts" heretofore used with such coils have been very wasteful of metal from which the "mount" was stamped, and unnecessary labor has been required to assemble the "mount" and the coil. I have devised a new type of "mount" in which the metal bracket used is capable of being stamped from strip material, with practically no wastage of material, and may be formed to shape by automatic machinery, and attached to the coil in a minimum of time and with a minimum of labor.

These features and others which will

hereinafter be more fully described make it possible to produce a highly efficient coil of the class described at an expense considerably less than that required to produce
 5 coils of corresponding efficiency as heretofore constructed, and render the coil particularly suited to production in large quantities or at high speed.

The features of novelty which I believe to
 10 be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its underlying principles and as to its practical embodiments will best be under-
 15 stood by reference to the specification and drawing, in which;

Figure 1 is a top plan view of a coil according to my invention, mounted upon a panel;

20 Figure 2 is a side elevation thereof partly broken away to show details of construction;

Figure 3 is a side elevation of the core of the stator member;

25 Figure 4 is a sectional view on lines 4—4 of Figure 2;

Figure 5 is a detail of the connecting lug 10;

30 Figure 6 is a sectional view on lines 6—6 of Figure 1, showing washers 34 and 35 and nut 18 removed;

Figure 7 is a detail showing the preferred form of shaft positioning means; and

35 Figure 8 is a section on line 8—8 of Figure 7.

Referring now more particularly to Figure 2 the coil according to my invention comprises for example a stator core member 1 having a winding 2 and if desired an
 40 additional winding 3, and a rotor core member 4 having a winding 5. The rotor and stator members are so arranged that the flux produced by each winding interlinks with the other windings whereby a
 45 considerable number of variable circuit combinations can be produced by connecting the windings as desired, and the diameter of the inner or rotor winding 5 should not exceed 60% of the diameter of the outer or
 50 stator member, whereby undesirable capacity coupling between the two windings is substantially eliminated, assuming the coils to be symmetrically disposed. I prefer to make contact to the rotor winding 5 by leaving a sufficient length of wire after the wind-
 55 ing of this member so that these ends may be brought out through stator core 1 to terminals 8 and 9. The ends of the winding 5 are preferably twisted together a plurality
 60 of times into a twist 6 which twist is taken through a hole 7 provided therefore in the stator core member 1.

If this were not done and the wires were connected directly to terminals 8 and 9 on
 65 the inside of core member 1, it would be

found that after a certain number of revolutions or partial revolutions of the rotor 4, the leads to the rotor would break off, due probably to the fact that the strain is of
 70 such nature as to bend the wires substantially at one point only. This ultimately crystallizes the metal, apparently, and results in a fracture, and this I find will hap-
 75 pen even though a large amount of slack is left. By twisting the leads as shown and carrying them through the stator core 1 this effect is eliminated and no amount of back and forth rotation of the rotor has as yet been found sufficient to crystallize and
 80 break the wires.

Turning now to the construction of stator core member 1, this will preferably be made of tubing such as that known as "bakelite", fiber or the like, cut to the proper length.
 85 Openings may then be formed, for instance by stamping, to provide axially extending wire carrying portions 15 and circumferentially extending spread-preventing edges 16. The winding may then be done as follows: One
 90 end of the wire is secured in any desired manner as by passing it through a hole in the core, so that a winding,—for example, winding 2—may be started adjacent one
 95 of the edges 16. The wire will then be wound around the core progressively across the openings, away from one set of edges 16 toward, and ending at, the opposite set of edges 16 as will particularly appear from
 100 Figures 2 and 4 and the end of the wire secured as above set forth. A winding is thus formed which covers only the openings
 105 in the core members, is supported by the axially extending sections 15 of the core member and prevented from shifting its position or spreading upon the core by the
 110 circumferentially extending edges 16 because the tension upon the wire causes the wire to take a position inside the edges 16, as will be noted from Figure 4. The rotor member may be constructed in a similar
 115 manner, except that the number of openings may be decreased if desired as shown in Figure 4.

To provide a coil which shall encircle the core still more tightly than any obtainable
 120 by winding as above described and to eliminate any possibility of displacement of the windings I prefer to heat the wire before winding so as to produce a substantial ex-
 125 pansion therein, and wind the same upon the core while still hot and expanded. If this winding operation is conducted with the same tension upon the wire as would be used if the wire were cold the contraction of the
 130 wire due to cooling thereof will cause the windings to grip the core more tightly and as a result a tension will be impressed upon the wire which is greater than the tension at which the wire could be wound successfully. This is particularly true when dealing with

the so-called "litz" wire made up of a plurality of separate strands, and which is preferred for high quality coils. Any considerable tension upon such wire while winding is apt to cause breakage of one or more of the strands, and the breakage of even one strand seriously affects the efficiency of the entire winding, as is well known in the art. However, the same wire will not fail under a tension sufficient to cause breakage in winding, when the tension is applied as I have described.

For the purpose of providing a connection between the ends of the wire and the terminal posts such as 8 and 9 which can be soldered without the use of a soldering iron I have provided a terminal lug 10 shown in detail in Figure 5. This lug comprises two portions, a screw receiving portion 11, having an opening therein, through which a binding post may be passed, and a laterally extending portion 12 provided with an upstruck U-shaped portion or tongue 13. In making a connection between wire 14 and lug 10 the wire is placed under the tongue portion 13 which is thereupon bent or pressed down to secure the wire 14 temporarily. It is to be noted that the end of the wire 14 is disposed so as to point away from the screw receiving portion 11 of the lug 10.

In order to make a soldered connection with such a lug it is only necessary to dip the lug, with the wire affixed thereto as above described, first into a soldering flux, and then into a pot of melted solder to the depth shown by the dotted line of Figure 5, so that the solder secures the end portion of the wire 14 to the laterally extending portion 12 of the lug. By the use of such lugs it will be found that any unskilled workman can turn out a larger number of soldered connections per unit of time than a skilled workman could by the use of a soldering iron, thereby decreasing the cost of each connection.

For the purpose of providing a "single hole mount" which will support the stator member 1 rigidly and at the same time support rotor member 4 rotatably, and which may be manufactured and assembled at as little expense as possible, both for material and workmanship, I have provided a shaft 17 secured at its inner end to the rotor member by means of a nut 18 and an associated threaded portion on the shaft. Shaft 17 is preferably provided with one or more flat surfaces 31 milled thereon and a correspondingly shaped opening is provided in rotor core 4. After the shaft is placed in position in rotor core 4 an ordinary washer 34 will preferably be placed on the end of shaft 17, then a lock washer 35 will be placed thereon, and finally, nut 18 will be run down and tightened. Shaft 17 passes through an opening in one side of stator core member 1, and

a pair of spring washers such as 19 and 20 are preferably disposed upon shaft 17 on opposite sides of the stator core member. These washers may be secured in position by means of adjustable collars 21 and 22 held in position by set screws 23 and 24, the latter of which is relatively longer than the former for a purpose which will be herein-after described as shown in Figure 1.

However, I prefer to use the shaft securing means shown in Figures 7 and 8, as it is more economical. In place of collar 21, I use a circular spring clip 33, mounted in groove 32, formed upon shaft 17 in any suitable way, as by cutting, thereby dispensing with collar 21.

A bracket member 25 is provided which is preferably formed of metal stamped to the desired shape and provided at each end with openings registering with openings in stator core member 1 so that bracket 25 may be bolted thereto. Either the bracket member or stator member, or both, may be provided with holes having considerable clearance, or with slots, so that in case of variation of either member from its theoretical shape or dimensions, the members may be securely bolted together without distorting the core and windings or unduly straining them.

It should be noted at this point that bracket 25 may be stamped with the least possible wastage of stock as there are no laterally projecting tongues, wings or the like which increase the wastage in stamping. Likewise the bending operations are few and very simple as will be seen by reference to Figs. 1 and 2, all of which contributes to the desired economy of manufacture.

The provision of a long set screw 24 eliminates the necessity of providing a stop member to limit rotation of the rotor 4, as the set screw 24 in rotation will strike opposite sides of bracket 25 and thereby limit the motion of rotor 4 to a little over 90°.

The spring washers and washer-positioning members already described form a resilient bearing for the shaft 17; i. e., it is possible to rock the shaft 17 slightly. In order to limit this rocking motion an additional bearing may be provided by the use of sleeve member 27. This sleeve member is preferably provided with screw threads coacting with internal screw threads in an opening in bracket 25 and a hexagonal flange 28 is formed on the outer end of said sleeve member so that a panel 30 or other support may be gripped between the flange 28 and flat portions 26 of bracket 25 thereby securing the stator member against rotation.

While I have shown and described the particular and preferred embodiment of my invention, it is clear that modifications and changes may be made as will be apparent to those skilled in the art without departing from the spirit and scope of my invention.

Having described my invention in such manner that it may be practiced by those skilled in the art and its benefits obtained, I declare that what I claim is:

1. In an electrical coil, in combination, a hollow cylindrical form having cut away sections defining a plurality of axially extending wire-supporting portions and circumferentially extending spread-preventing edges, the angle subtended at the axis of said form by the arc of said cut away sections being of sufficient magnitude to permit the chord of said arc to lie materially within the projection of the circumferential surface of said form at the middle of said cut away sections, and a winding comprising a plurality of turns of wire closely wound on said core and filling said cut away sections and held laterally in position by said spread preventing edges.
2. A method of manufacturing electrical coils having a plurality of turns of wire wound upon a core which comprises heating the wire to be wound to cause expansion thereof and winding the wire upon the core while expanded.
3. A method of manufacturing coils having a plurality of turns of wire wound upon a core, which comprises heating expandible wire, and winding said wire upon said core while hot.
4. A method of manufacturing electric coils having a plurality of turns of wire wound upon a core member, which comprises heating the wire to be used, and winding said wire while hot upon said core member with the normal winding tension.
5. A method of manufacturing electric coils having a plurality of turns of wire wound upon a hollow core member, which comprises forming openings in said core member defining a plurality of axially extending, wire-supporting portions, heating the wire to be used, and winding said wire while hot over said supporting portions.
6. A method of manufacturing electrical coils having a plurality of turns of wire wound upon a hollow cylindrical core member, which comprises forming openings in said core member defining a plurality of axially extending, wire-supporting portions, and circumferentially extending spread-preventing edges, and winding the wire closely over said wire-supporting portions only, to

completely fill the space between said spread-preventing edges.

7. A method of manufacturing electrical coils having a plurality of turns of wire wound upon a hollow cylindrical core member, which comprises forming openings in said core member defining a plurality of axially extending wire-supporting portions and circumferentially extending, spread-preventing edges, heating the wire, and winding the wire while hot, closely over said wire-supporting portions only, to fill the space between said spread-preventing edges.

8. In an electrical coil, in combination, a hollow cylindrical form having cut away sections defining a plurality of axially extending wire supporting portions and circumferentially extending spread-preventing edges, and a plurality of turns of wire closely wound thereon over said supporting portions and between said spread-preventing edges, the distance between said wire supporting portions being so chosen with respect to the winding that the angle subtended at the axis of said form by the arc of said cut away sections is of sufficient magnitude to permit the chord of said arc to lie materially within the projection of the circumferential surface at the middle of said cut away sections whereby said winding is maintained against axial shifting by engagement of the outer turns thereof with said spread-preventing edges.

9. In an electrical coil, in combination, a hollow cylindrical form having cut away sections defining a plurality of axially extending spaced wire supporting portions and circumferentially extending spread-preventing edges, and a plurality of turns of wire closely wound thereon over said wire-supporting portions, and between said spread-preventing edges, the space between said supporting portions being so chosen that the angle subtended at the axis of said form by the arc of said cut away sections is of sufficient magnitude to permit the chord of said arc to lie materially within the projection of the circumferential surface at the middle of said cut away sections whereby the winding passes between adjacent supports as a chord within said spread-preventing edges and is thereby maintained against axial shifting.

In testimony whereof I affix my signature.
JOSEPH TILLOU SATTELS.