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C. A. PURDY

1,748,993

ELECTRICAL COIL AND METHOD OF MANUFACTURING IT

Filed Oct. 19, 1926

Fig. 1.

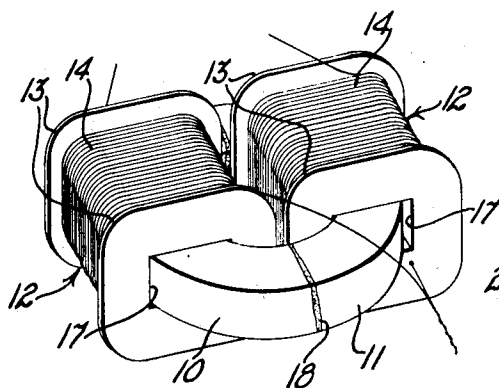


Fig. 2.

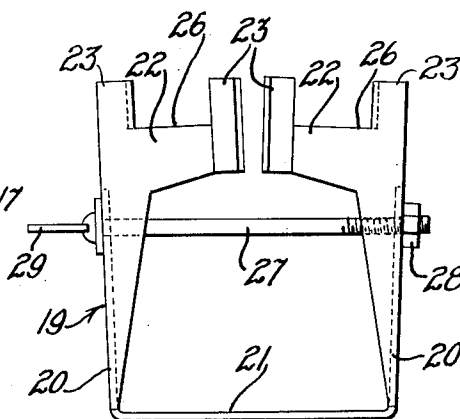


Fig. 3.

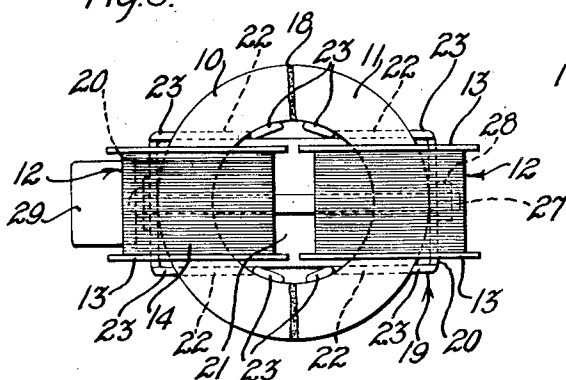


Fig. 4.

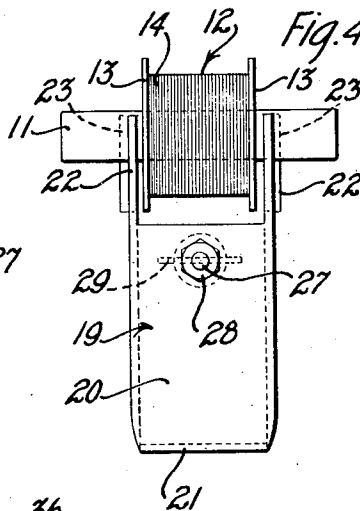
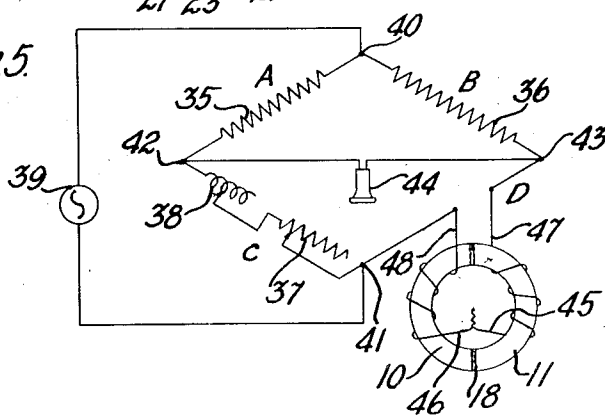


Fig. 5.



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UNITED STATES PATENT OFFICE

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ELECTRICAL COIL AND METHOD OF MANUFACTURING IT

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This invention relates to electrical coils and a method of manufacturing them, and more particularly to inductance coils having toroidal type cores and a method of manufacturing them.

One type of inductance toroidal core coils which is used in connection with telephone lines to which this invention is particularly applicable comprises two coils having a large number of turns of fine wire wound thereon, the coils being assembled on two substantially identical arcuate sections of a ring core composed of magnetic material, which have heretofore been permanently clamped together with non-magnetic clamping elements. The manufacture of an inductance coil of this type with predetermined electrical properties is a comparatively difficult and expensive procedure in that in the winding of the coils thereof an excess number of turns of wire are frequently wound thereon which in the subsequent inductance adjustment of the coil requires the removal of a large portion thereof and in some cases the addition of turns of wires to provide a coil of predetermined electrical characteristics.

The objects of this invention are to provide an improved type of electrical coil and a method of manufacturing them to a definite inductance in a simple, inexpensive and expeditious manner.

In accordance with the objects of this invention as practiced in connection with the manufacture of toroidal core inductance coils of the type hereinbefore described the two sections of the ring core with their respective coils mounted thereon are assembled with a non-magnetic cementing material applied in plastic form between the adjacent opposite ends. The thus assembled coils and the respective core sections are mounted upon an adjustable clamping fixture where the core sections are each individually adapted to be moved toward or from each other in a direction at substantially right angles to the opposed cemented ends whereby the air gap may be adjusted until a predetermined definite inductance is obtained as indicated by a suitable bridge or test circuit connected to the windings of the coil. With this adjustment of the

air gap it is not necessary to remove or add any turns of wire to the coil sections. After obtaining the desired inductance the coil is disconnected from the bridge circuit and the plastic cement is allowed to harden to provide a permanent air gap whereupon the coil is removed from the clamping fixture and is then ready to be incased or mounted without further clamping means being applied to retain the core sections in assembled relation.

Other objects and advantages of this invention will more fully appear from the accompanying detailed description taken in connection with the accompanying drawing which illustrates one embodiment thereof, in which

Fig. 1 is a perspective view of a completed inductance toroidal core coil embodying the features of this invention before it is incased or mounted;

Fig. 2 is a side elevation of an assembling fixture used in practicing the method of manufacturing the coil illustrated in Fig. 1;

Fig. 3 is a plan view thereof with a coil in position thereon;

Fig. 4 is an end view thereof, and

Fig. 5 is a schematic diagram of a coil connected to a bridge circuit for indicating when the magnetic gap of the coil has been adjusted to provide a definite inductance.

An inductance toroidal core coil embodying the features of this invention may be manufactured according to the following method. Referring to the drawings, particularly Fig. 1 which illustrates a completed coil before being incased or mounted, the numerals 10 and 11 indicate semi-toroids, forming the core of the coil, which may be composed of any suitable magnetic material. In practice, it has been found desirable to form the core first in the form of a continuous ring from finely divided iron particles, the individual particles of which are coated with a thin insulating film which are then formed under high pressure into a ring in a well known manner. The ring thus formed after being coated with a thin insulating film is suitably broken into two substantially identical circumferential sections or semi-toroids 10 and 11. Upon each of the semi-toroids equi-distant the ends thereof is

mounted a spool 12 provided with heads 13 at opposite ends and having a large number of turns of fine wire 14 wound thereon between the heads, the spools being provided with apertures 17 adapted to receive the core sections. The broken ends of the core sections 10 and 11 are then treated with a suitable non-magnetic plastic cement 18 which hardens slowly at room temperatures. In case it is desired to hasten the hardening the coil may be placed in a heated oven.

According to one embodiment of the invention, a cement having a low coefficient of expansion under temperature change after hardening is employed. A cement having these qualities which has been found to be particularly suited for the purpose herein described is known under the trade name of "Ambroid".

The two core sections thus treated with the cement 18 and supporting the spools 12 of wire are mounted upon an adjustable clamping fixture 19 (Figs. 2, 3 and 4) with the original broken ends in adjacent relationship and spaced apart by the cement 18 to form a non-magnetic gap for breaking the continuity of the magnetic circuit. The fixture 19 will now be described.

The fixture 19 comprises a pair of similarly shaped diametrically disposed arms 20 extending vertically form a horizontally disposed common supporting base 21, the whole being formed integrally from non-magnetic sheet material such as brass. The upper ends of the arms 20 are each provided with a pair of inwardly extending arms 22 formed at right angles thereto. Formed upon each of the arms 22 is a pair of vertically extending jaws 23 which are suitably spaced from each other and set at an angle with respect to the arms 22 so that they snugly engage the outer and inner curved vertical surfaces of the arcuate sections of the ring core, as clearly indicated in Fig. 3, upon the coil sections being associated therewith, the lower surfaces of the core sections resting upon upper horizontal edge surfaces 26 of the arms 22 intermediate each pair of jaws 23. The arms 20 and base 21 are tensioned in the forming of the fixture so that the arms 20 are normally urged apart for a suitable distance, as clearly shown in Fig. 2. To provide positive motion between the arms 20 to bring them closer together a rod 27 extends from one arm to the other intermediate the arms 22, as viewed in Fig. 3, and through openings provided therein. One end of the rod 27 is threaded into a nut or lug 28 preferably soldered to the associated arm 20, while the opposite end of the rod is equipped with a thumb piece 29. It will be evident that the normal tension provided in the fixture as hereinbefore mentioned and a manipulation of the threaded rod 27 provides means whereby the arms 22 may be adjusted horizontally in either direction to

vary the space between the opposed pairs of jaws 23 provided upon the inner ends of the arms 22.

Fig. 5 illustrates in diagrammatic form an electrical Wheatstone bridge circuit which is used in the inductance adjustment of the coils manufactured in accordance with the herein described method. In this diagram A and B represent the usual fixed ratio arms comprising resistances 35 and 36, C a variable arm including an adjustable resistance 37 and an adjustable inductance resistance 38, and D the unknown resistance arm of the bridge circuit comprising the coil to be adjusted to a predetermined inductance. An electromotive force supply source 39 of audio frequency alternating current is connected to the points 40 and 41, while the circuit between the points 42 and 43 includes a telephone receiver 44 which is used in a well known manner to indicate to the operator when the bridge circuit is balanced.

The method of integrally uniting the core sections 10 and 11 with their respective spools or coils 12 mounted thereon and adjusting the non-magnetic gap between the opposite core sections until the desired inductance of the coils is obtained is as follows:

The broken ends of the core sections 10 and 11, as hereinbefore described, are treated with the plastic non-magnetic cement 18 after the mounting of the coil thereon. Thereafter the core sections are placed by the operator upon the two arms 22 of the fixture 19 which normally assume the position shown in Fig. 2, with the inner and outer curved vertical surfaces of the core sections lying between the jaws 23 of the arms 22 and their lower surfaces resting upon the upper horizontal edge surfaces 26 of the arms 22, as clearly shown in Figs. 3 and 4. The two coils 12 carried by the core sections are then connected to the bridge circuit to form the unknown arm D thereof, as hereinbefore described and shown in Fig. 5, with the inner and outer ends 45 and 46, respectively, of the wires forming the two coils connected together and the outer and inner ends 47 and 48, respectively, thereof serially connected to the arm D. Before the adjusting operation takes place it is to be understood that the variable arm C of the bridge circuit has been set by adjusting the inductance resistance 38 for the desired coil inductance and that the adjustable resistance 37 has also been set to correspond to the resistance of the coil under adjustment. The core sections 10 and 11 are then moved toward each other in the manner hereinbefore described by turning the rod 27, the space between the core sections being bridged by the plastic cement 18. While thus varying the non-magnetic gap the operator is holding the receiver 44 to his ear and upon the inductance in the unknown arm D equalling the inductance in the arm C, which as hereinbefore

described has been set for the inductance desired in the coil under adjustment, the high frequency hum of the alternating current source 39 across the points 40 and 41 will not be heard by the operator, since no current will flow between the points 42 and 43 when the bridge circuit is in balance. This indicates to the operator that the inductance adjustment of the coil is completed, the coil ends 47 and 48 are then disconnected from the bridge circuit and the assembled adjusted coil still clamped to the fixture is set aside to permit the cement 18 to harden at room temperature or it may be placed in a heated oven to accelerate the hardening thereof. The coil is then released from the fixture 19 and is ready to be incased or mounted without further clamping means being applied to retain the core sections in assembled relation.

What is claimed is:

1. The method of manufacturing electrical coils which consists in placing a winding on a divided core, positioning a plastic non-magnetic material between the ends of the core which provides an air gap between the core sections, and adjusting said air gap with the non-magnetic material in a plastic state until predetermined electrical properties are obtained.

2. The method of manufacturing electrical coils which consists in forming a core, dividing the core into a plurality of substantially identical sections, placing windings thereon in sections, assembling the core sections in spaced relation with a plastic non-magnetic material bridging the space therebetween, and then varying the space between the core sections until a definite predetermined effect is obtained in the coil.

3. The method of manufacturing electrical coils which consists in forming a core of magnetic material, dividing the core into a plurality of sections, placing windings thereon in sections, treating a surface of one core section with a plastic non-magnetic material, assembling the core sections in spaced relation with a plastic non-magnetic material, bridging the space between the core sections, connecting the windings with an electrical test circuit, and then varying the space between the core sections until a definite predetermined effect is obtained in the coil as indicated by the test circuit.

4. The method of manufacturing electrical coils, which consists in forming a core, fracturing the core to provide a plurality of sections having opposed irregular surfaces, placing a winding on the core, positioning a plastic non-magnetic material between the irregular core surfaces which provides an air gap between the core sections, and adjusting said air gap until predetermined electrical properties are obtained.

5. The method of manufacturing electrical

coils, which consists in placing a winding on a divided core, positioning a cementitious non-magnetic material between the ends of the core which provides an air gap between the core sections, and adjusting said air gap before the cementitious material becomes effective until predetermined electrical properties are obtained.

6. The method of manufacturing electrical coils, which consists in forming an endless core, dividing the core into sections, placing windings thereon in sections, assembling the core sections in spaced relation to provide an air gap therebetween, bridging the air gap by a plastic non-magnetic material, and then varying the air gap between the core sections until a definite predetermined effect is obtained in the coil.

7. The method of manufacturing electrical coils, which consists in forming an annular core, dividing the core into a plurality of sections, placing windings thereon in sections, assembling the core sections in spaced relation to provide an air gap therebetween, bridging the air gap by a plastic non-magnetic material, and then varying the air gap between the core sections with the non-magnetic material in a plastic state until a definite predetermined effect is obtained in the coil.

8. An inductance coil having a core formed of separated sections, and a quantity of non-magnetic cementing material between the sections permitting adjustment of the air gap between the sections and upon solidification integrally uniting the sections.

9. An inductance coil having a core formed of a plurality of substantially identical semi-toroids spaced apart at diametrically opposite points, and a non-magnetic cementing material in the space between the semi-toroids to allow for adjustment of the air gap between the semi-toroids and upon its solidification integrally uniting the semi-toroids.

10. In an inductance coil having a core formed of magnetic material separated at opposite points, a cementitious non-magnetic spacer allowing initial relative adjustment of the points to vary the air gap and integrally uniting the points.

In witness whereof, I hereunto subscribe my name this 4th day of October, A. D. 1926.

CHESTER ARTHUR PURDY.