S. E. JOHANNESEN.

STATIONARY INDUCTION APPARATUS.

APPLICATION FILED AUG. 5, 1918.

1,360,752. Patented Nov. 30, 1920.

Fig. 1.

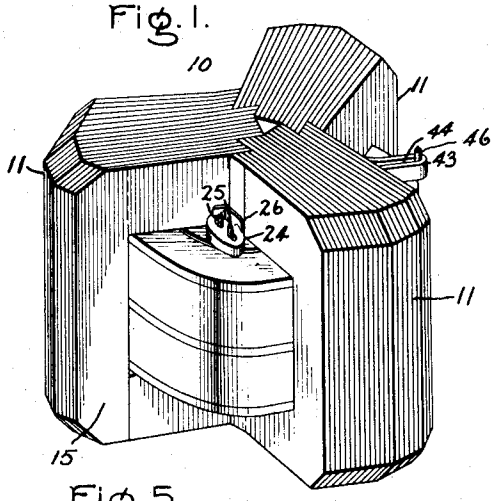


Fig. 2.

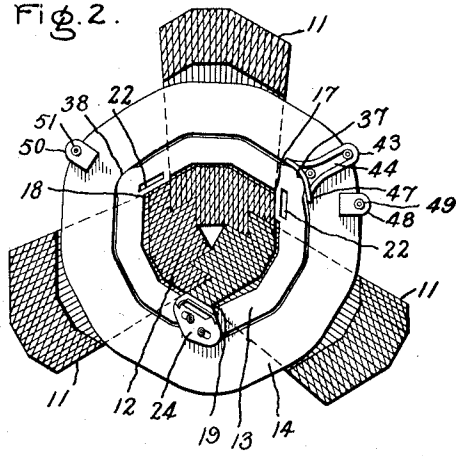


Fig. 5.

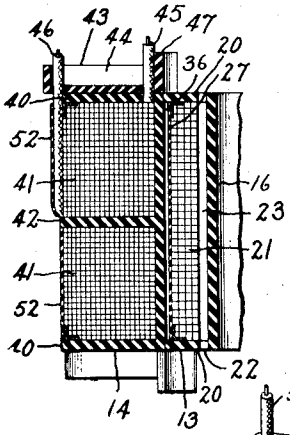


Fig. 3.

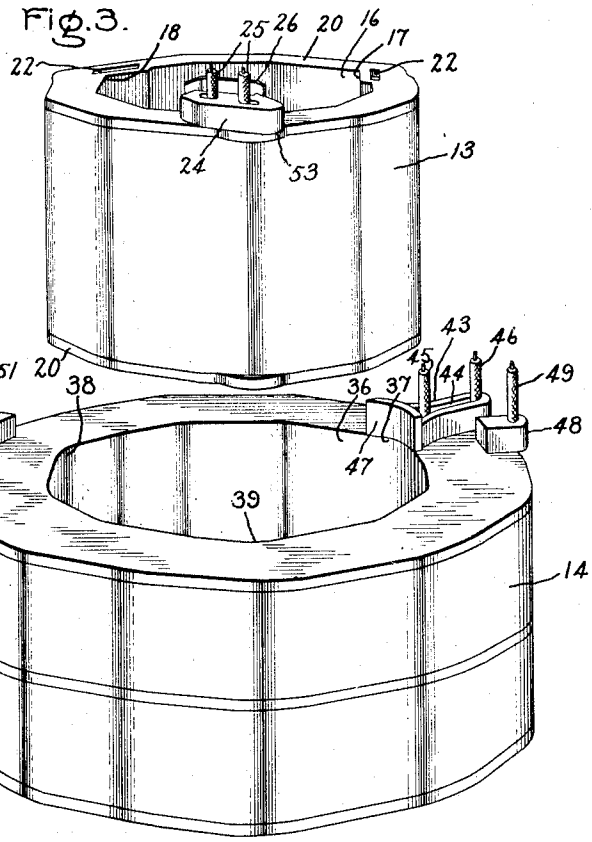


Fig. 4.

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UNITED STATES PATENT OFFICE.

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STATIONARY INDUCTION APPARATUS.

1,360,752. Specification of Letters Patent. Patented Nov. 30, 1920.

Application filed August 5, 1918. Serial No. 248,269.

To all whom it may concern:

Be it known that I, SVEND E. JOHANNESEN, a citizen of the United States, residing at Pittsfield, in the county of Berkshire, State of Massachusetts, have invented certain new and useful Improvements in Stationary Induction Apparatus, of which the following is a specification.

My invention relates to electrical apparatus such as transformers, some reactances and the like in which a plurality of separate windings are assembled on a core of magnetic material, and has for its object an improved construction therefor whereby such apparatus may be more readily and more economically manufactured than heretofore.

Transformers, reactances, etc., have heretofore either had the windings wound on the core when in a partially or completely assembled condition, or the windings are form wound and assembled on the core subsequently. In either case much insulating material, barriers and spacing devices must be put in place during the process of assembly which requires both time and skill on the part of the mechanic so that a large personal equation heretofore has been involved in the manufacture of this type of electrical apparatus.

In the practice of my invention this personal equation is largely eliminated for I have provided a plurality of insulating spools, on which the windings may be wound mechanically and slipped into place on the core without any additional insulating material, barriers or spacing devices.

Such spools as I have provided are preferably so formed that improper assembly is impossible and form, when assembled, rigid supports for the windings, having proper ventilating facilities.

These spools may, with advantage be so formed as to provide all desirable barriers for the leading-in conductors which would ordinarily be placed therebetween and the core; such barrier formations also serving, in some instances, as terminal boards.

For a more complete understanding of the nature and objects of my invention, reference should be had to the following detailed description of my invention as applied to the construction of transformers when taken in connection with the accompanying drawing in which Figure 1 is a perspective view of an assembled transformer of the distributed core type having the wound spools embodying my invention in assembled position. Fig. 2 is a section taken on a horizontal plane in Fig. 1. Figs. 3 and 4 are perspective views of the inner and outer spools respectively, and Fig. 5 is a cross-section through the spools in assembled relation.

Referring now to the drawings, 10 denotes a distributed core having three outer legs 11 and a central leg 12 which may be polygonal in cross-section, involving the construction set forth in my Patent 1,282,086 issued October 22, 1918.

The inner spool 13 and the outer spool 14, having respectively the low voltage and high voltage windings thereon, are slipped over the central leg 12 before the L-shaped laminar elements 15 are put in place to form the outer legs 11.

The spools 13 and 14 are preferably made of moldable insulating material such as bakelite; the inner spool 13 having a cylindrical or prismatic inner wall 16 designed to follow generally the contour of the polygonal central leg 12.

The wall 16 is made to engage preferably with three edges of the leg 12 indicated at 17, 18 and 19 so as to be maintained rigidly in a predetermined position on the leg. At all other points the wall 16 is formed to be slightly spaced from the leg 12 so as to provide a ventilating passage for the circulation of cooling and ventilating medium between the core and the windings.

The spool 13 is also provided with flanges 20 at both ends, which flanges together with the wall 16 provide all the insulating material and barriers necessary to protect the low voltage windings, shown at 21 in Fig. 5, from the core 10.

The flanges 20 are also shown as mortised at 22 to provide openings for the admission of the cooling medium to the windings 21; the wall 16 being preferably offset at these points to provide a passage as shown at 23 for the cooling medium entering or leaving openings 22.

The winding 21 is wound on the spool 13 in continuous superposed layers; the spool 13 being preferably formed with an integral molded formation 24 for supporting the starting and finishing leading-in conductors 25 of the winding 21, such formation also having a barrier 26 for protecting these leading-in conductors from the core 10. The

winding 21 may also be overlaid by a layer of insulating material as shown at 27 to assist in holding it in place, but such layer is by no means necessary and is frequently dispensed with.

The spool 14 also has a cylindrical or prismatic wall 36 following in a general way the contour of the flanges 20 on the spool 13 which is nested in the outer spool 14; such wall being designed to engage each flange 20 of the spool 13 at preferably three points 37, 38 and 39 so as to be held rigidly in a predetermined position. Such points of contact may correspond to the vertices of an equilateral triangle but preferably correspond to the vertices of an unequal sided triangle so that the spools 13 and 14, when assembled or nested together, bear a predetermined relation to one another. At all other points in its contour the wall 36 is spaced away from the flanges 20 so as to provide for the circulation of the cooling medium between it and the low voltage windings 21.

The wall 36 is provided with flanges 40 at each end, which flanges together with wall 36 provide all the necessary insulating material for insulating the high voltage windings 41 both from the low voltage winding 21 and from the core 10.

The winding 41 is placed on spool 14 in a manner similar to the winding 21 on spool 13, such winding consisting of successive continuous layers. The spool 14, however, preferably is provided with one or more integral barriers 42 for reducing the number of turns in a layer of the high voltage winding 41 so that the voltage between layers need not be excessive.

Each flange 40 is provided with one or more integral formations to support and protect the leading-in conductors for the winding 41. The top flange is provided as shown with a formation 43 having a channel 44 at the inner end of which is an opening for the insertion of the starting lead 45 of one section of the winding 41, the other end having an opening for the finishing lead 46. The formation 43 is also provided with a barrier 47 for protecting the lead 45 against the low voltage winding.

Adjacent the formation 43, there is a formation 48 for supporting the starting lead 49, of the other section of winding 41, on the upper flange 40, which lead is passed into the channel in a formation on the lower flange precisely similar to the formation 43 on the upper flange, which passage is first through the outer opening in the formation, then in the channel, and finally through the inner opening.

A third formation 50 is shown on the upper flange 40 at some distance from the formations 43 and 48, and supports the finishing lead 51 of the lower section of winding 41.

I have also shown layers 52 of insulating material in Fig. 5 for assisting in supporting the windings 41 in place and serving as insulation between the high voltage winding and core structure, similar to the layer 27 which assists in supporting winding 21, and may also serve as insulation for the upper and lower edges of the low voltage windings against the core.

In order that the nested spools may not readily be disposed axially when in their assembled relation, I have slightly offset the formation 24 on the spool 13 as shown at 53 so as to anchor it on the spool 14 in a desired relation.

It is thus seen that with the use of spools constructed in accordance with my invention, windings for electrical apparatus will be supported and maintained in predetermined relations without the use of additional supports, barriers or spacing devices resulting in a product which when machine wound can be easily assembled by unskilled workmen without liability of error.

It will of course be understood that it is only necessary to use layers of insulating material, such as I have shown at 27 and 42 for insulating purposes in addition to their supporting function (which layers are then preferably made of the same material as that in the spools), only when the windings on the spools extend but so far that the thickness of the oil film between the windings and core is insufficient or when the creepage distance from the windings to the core is very short. In some instances I contemplate using only sections of insulation between the windings and the outer legs.

Having now described what is at present the best means known to me for carrying out an embodiment of my invention, I would have it understood that such means are merely illustrative, and that I do not mean to be limited thereby to the exact details shown nor in the choice of recognized equivalents except as defined in my claims hereunto appended.

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

1. In an electrical apparatus, the combination with a core, of a plurality of insulating spools nested in each other surrounding a leg of said core, and windings on each spool, said spools being provided with complementary formations adapted to interlock said spools with each other and with said core in predetermined positions.

2. In an electrical apparatus, the combination with a core, of a plurality of polygonal insulating spools surrounding a leg of said core, said spools being nested and formed to engage with each other and with said core in a predetermined manner, and windings on each of said spools.

3. In an electrical apparatus, the com-

bination with a core, of a plurality of insulating spools surrounding a leg of said core, said spools being nested and formed with outstanding projections to engage with each other and with the core at a plurality of predetermined points, at all other points the spools and core having a spaced relation in order to afford ventilating passages, and individual windings on each of said spools.

4. In an electrical apparatus, the combination with a core, of a plurality of insulating spools surrounding a leg of said core in nested relation, and windings on said spools; each of said spools being formed of molded insulating material and having portions in relief adapted to provide a desired spacing and ventilation of the winding thereon.

5. In an electrical apparatus, the combination with a core, of a plurality of insulating spools surrounding a leg of said core, and individual windings on said spools, said spools being nested and formed with integral supports and protecting barriers for the leading-in conductors of said windings.

6. In an electrical apparatus, the combination with a core, of a plurality of insulating spools surrounding a leg of said core, and individual windings on said spools, said spools being nested and having flanges formed to engage each other and said core only at a plurality of predetermined points, thereby forming ventilating passages between said windings, certain of said flanges being mortised to provide additional ventilating passages.

7. In an electrical apparatus, the combination with a core, of a plurality of insulating spools surrounding a leg of said core, and individual windings on said spools, said spools being nested and having flanges formed to engage each other and said core only at a plurality of predetermined points, said flanges being provided with integral formations for supporting the leads of said windings.

8. In an electrical apparatus, the combination with a core, of a plurality of insulating spools surrounding a leg of said core, and individual windings on said spools, said spools being nested and having flanges formed to engage each other and said core only at a plurality of predetermined points, said flanges being provided with integral formations for supporting the winding leads and integral barriers for protecting said leads from adjacent windings and from said core.

9. In a transformer, the combination with a distributed core, of nested inner and outer spools of molded insulating material surrounding the central leg of said core, a low voltage winding on the inner spool and a high voltage winding on the outer spool.

10. In a transformer, the combination with a distributed core, of nested inner and outer spools of molded insulating material surrounding the central leg of said core, a low voltage winding on the inner spool and a high voltage winding on the outer spool, each spool comprising a prismatic wall and a flange at each end formed to engage with each other and with said central leg only at a plurality of predetermined points.

11. In a transformer, the combination with a distributed core, of nested inner and outer spools of molded insulating material surrounding the central leg of said core, a low voltage winding on the inner spool and a high voltage winding on the outer spool, each spool comprising a prismatic wall and a flange at each end formed to engage with each other and with said central leg only at a plurality of predetermined points, the inner spool being provided with an anchoring device to prevent axial displacement.

12. In a transformer, the combination with a distributed core, of nested inner and outer spools of molded insulating material surrounding the central leg of said core, a low voltage winding on the inner spool and a high voltage winding on the outer spool, the inner spool comprising a primatic wall arranged to engage with said central leg along but three predetermined edges thereof and flanges having integral formations for securing and protecting the leads for said low voltage winding, the outer spool comprising a prismatic wall having flanges engaging with the respective flanges on the inner spool at but three predetermined points, said outer flanges also having integral formations for securing and protecting the leads for the high voltage winding, and an integral barrier, intermediate the flanges on said outer prismatic wall for reducing the voltage between layers in said high voltage winding.

13. In an electrical apparatus, the combination with a distributed core, of a plurality of irregularly conformed nested insulating spools adapted to interlock with each other surrounding the central leg of said core, windings on said spools, and layers of insulating material overlaying said windings.

14. In a transformer, the combination with a distributed core, of a plurality of irregularly conformed nested insulating spools surrounding the central leg of said core, arranged to engage with each other and with said core in a predetermined manner, and spaced to provide ventilating passages therebetween, and strips of insulating material overlaying said windings where desired.

15. In a transformer, the combination with a distributed core provided with a polygonal central leg, of a plurality of

nested insulating spools surrounding said central leg, said spools having a polygonal shape formed to correspond with the cross section of said central leg, and windings on each of said spools.

16. In a transformer, the combination with a distributed core having a polygonal central leg, of a plurality of molded insulating spools shaped to nest with each other and to have a polygonal form corresponding with the cross section of said central leg, windings on said spools, and terminal supporting formations molded on said spools at predetermined points for supporting the terminals of said windings in desired relative positions.

In witness whereof I have hereunto set my hand this first day of August, 1918.

SVEND E. JOHANNESEN.