June 6, 1933. V. G. APPLE 1,913,138

VENTILATED ELECTROMAGNETIC STRUCTURE

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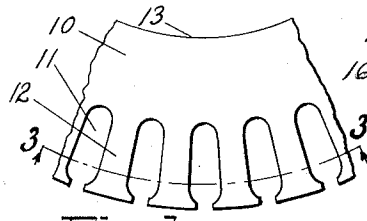


Fig. 1.

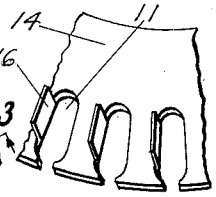


Fig. 2.

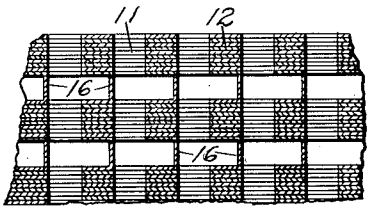


Fig. 3.

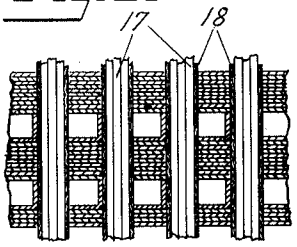


Fig. 4.

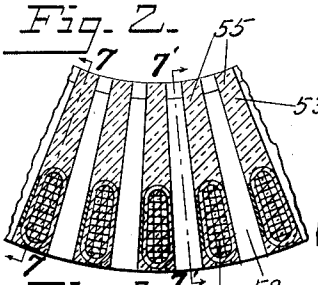


Fig. 5.

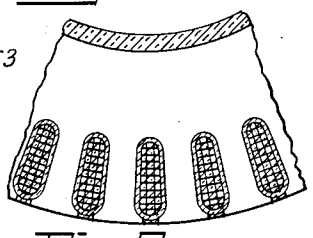


Fig. 9.

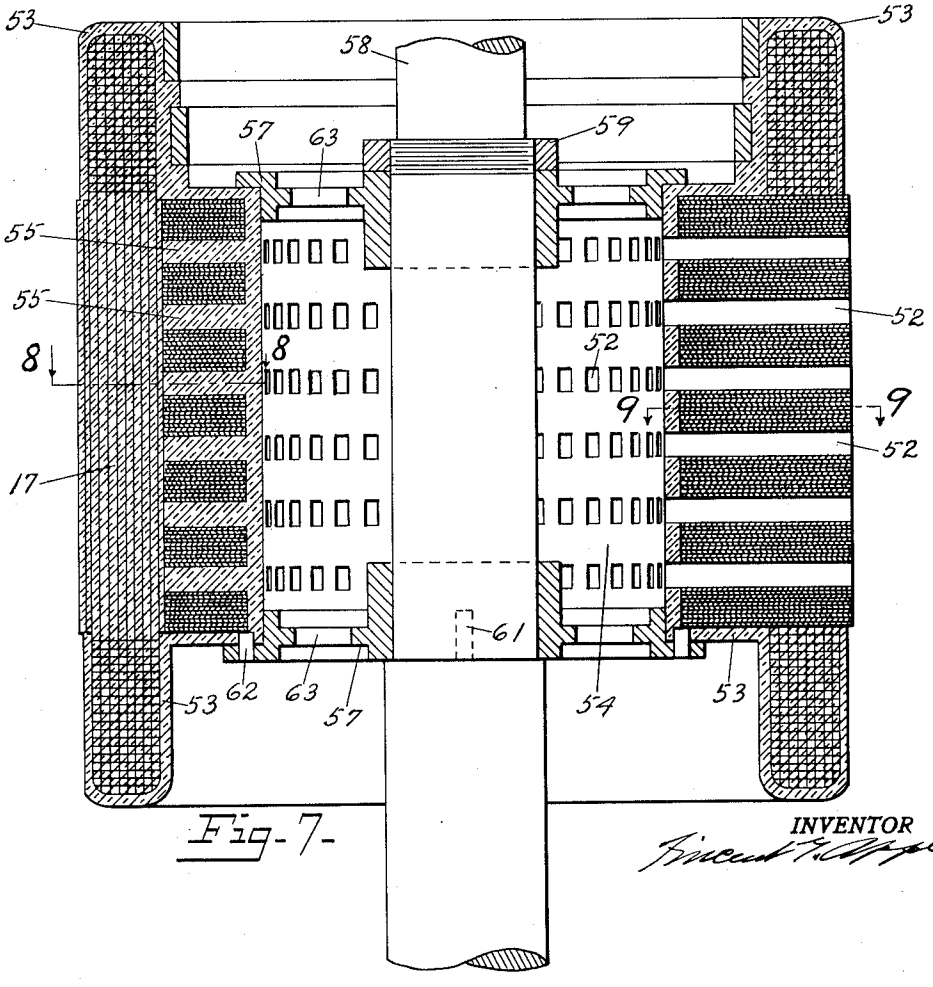


Fig. 7.

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VENTILATED ELECTROMAGNETIC STRUCTURE

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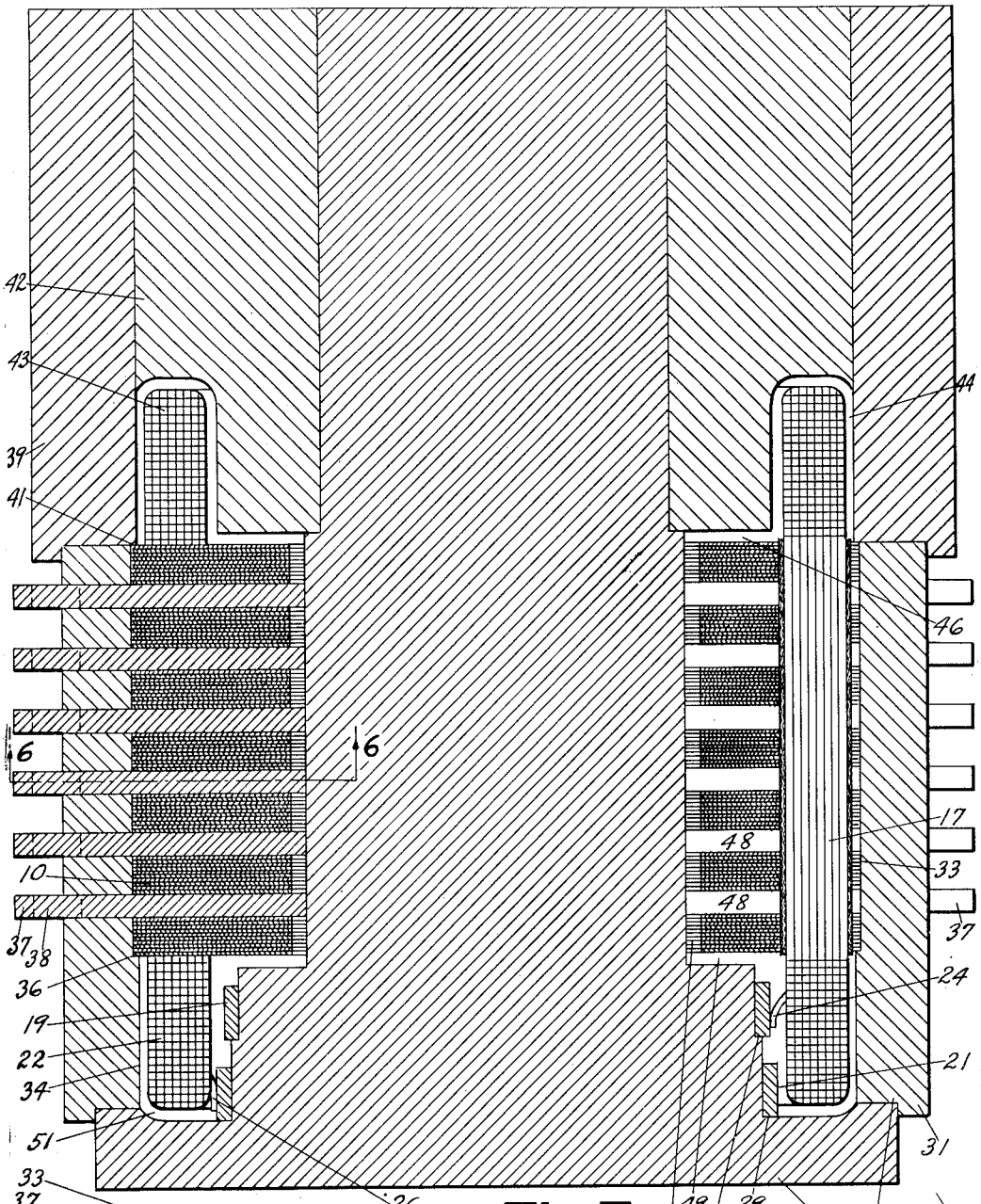


Fig. 5.

Fig. 6.

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UNITED STATES PATENT OFFICE

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VENTILATED ELECTROMAGNETIC STRUCTURE

Application filed July 10, 1930. Serial No. 467,008.

This invention relates to electromagnetic structures wherein the core laminæ are spaced apart at intervals for ventilation.

The object of the invention is to provide a structure wherein the core is composed of spaced apart groups of laminæ, and where the entire winding is imbedded and encased in a solid mass of insulation.

I attain this object by the structure hereinafter described, reference being had to the drawings wherein—

Fig. 1 is a fragmentary end view of an armature core selected to illustrate my invention.

Fig. 2 shows a fragment of a special laminæ used at intervals in my core.

Fig. 3 is a fragmentary cross section taken at 3—3 of Fig. 1.

Fig. 4 shows the section Fig. 3 but with the bundles of wires composing the winding in the core slots.

Fig. 5 is an axial section through a mold in which the armature is insulated, the left side being taken through 5—5 of Fig. 6 and right side through 5′—5′ of Fig. 6.

Fig. 6 is a fragmentary section taken at 6—6 of Fig. 5.

Fig. 7 is an axial section through the completed armature, the left side taken at 7—7 and the right side at 7′—7′ of Fig. 8.

Figs. 8 and 9 are fragmentary sections taken at 8—8 and 9—9 respectively of Fig. 7.

Similar numerals refer to similar parts throughout the several views.

In dynamo electric machine elements of large size it is common practice to provide a ventilating means to assist in cooling the element by leaving out groups of several laminæ each throughout the length of the core. Such a structure comprises in effect a number of short core sections in axial alignment with some sort of spacers between the several sections to keep them apart.

Such large size elements are usually bar wound, and when the bars composing the winding are laid in the core slots they necessarily cross the open spaces between the several sections of the core. In a revolving element constructed in this fashion the parts of the winding bars which cross these open spaces have the same effect as the blades of a centrifugal blower to move a cooling medium outwardly through the spaces between the core sections.

But when this same core is wound with a large number of relatively fine wires in each core slot the problem is more difficult, since the coils of wire which fill a slot must cross the open spaces between the core sections and some provision is preferably made to keep the wires of the coils together and to insulate them. In the present invention this is accomplished by molding an integral mass of insulating material to extend through, between and completely around the several turns of the winding and about the winding heads at the ends of the core, the parts of the mass at the ends of the core being joined by integral struts of insulation extending through the slots and by an integral cylinder of insulating lining the inner diameter of the core the insulation mass at the same time providing permanent spacing means to hold the several core sections spaced apart. The struts which extend through the core slots completely surround and enclose the coils of wires therein, the wires acting as reinforcement for the struts. The coils of wire are thus not only enclosed where they pass through the slots but also where they bridge the spaces between the core sections.

The laminated core 10, Fig. 1 has winding slots 11 separated by teeth 12. There is a large central opening 13. The core is composed mostly of laminæ of conventional design but at intervals a special lamina 14, Fig. 2 having temporary spacing lugs 16 is interposed. The lugs 16 are turned up from part of the metal ordinarily removed when the slots 11 are punched. Fig. 3 is a fragmentary

section of a core 10 showing how the lugs 16 keep the several core sections spaced apart.

Fig. 4 shows the same fragment as is shown in Fig. 3 but with the coils 17 of wire composing the winding in the slots. Before the coils are laid in the slots the slots are lined, preferably with a coarse loosely woven fabric 18 which holds the coils away from the sides of the slots until the permanent insulation in fluid form may be forced into the space, after which the fabric serves merely as reinforcement for the permanent insulation.

Fig. 5 shows the core 10 with its coils 17 and suitable collector rings 19 and 21 located within the winding head 22 in the insulating mold 23. The coils are attached to the collector rings 19 and 21 at 24 and 26 respectively.

The mold 23 comprises a one piece base and center plug 27 which has shoulders 28 and 29 upon which rings 19 and 21 rest. The cylinder 31 is concentrically supported on the base at 32. The opening through cylinder 31 is of two diameters. At 33 it fits the core sections, while the smaller opening 34 provides a shoulder 36 upon which the core may rest.

A plurality of side pulls 37 extend through the wall of cylinder 31 in circular rows. There are as many rows as there are open spaces between the core sections and as many pulls in a row as there are teeth in the core. Pulls 37 have tapered sides and when in place occupy the spaces between coils 17 and extend radially inward until they touch the center plug 27. Notches 38 in the sides of the pulls provide means to engage them to withdraw them after insulation of the armature has been effected.

A stock ring 39 fits over the upper end of cylinder 31. The opening through the stock ring is somewhat smaller than the core 10, the end resting on the core at 41 to hold it in place. A hollow plunger 42 has an outer diameter slidably fitted to the stock ring and an inner diameter slidably fitted over the center plug 27. The lower end of the plunger 42 is shaped out to make room for the winding head 43.

Mold 23 is shown closed about the armature as it appears before any of the insulation has been placed, and it will be seen that there is continuity between the space 44 around the upper winding head 43, the space 46 at the upper end of the core, the spaces 47 between the center plug 27 and the core 10, the spaces 48 left between adjacent pulls 37 and between adjacent core sections, the space 49 at the lower end of the core, and the space 51 around the lower winding head 22 and the rings 19 and 21, so that insulation placed in the mold at the upper end of the core may be fluxed and forced downwardly into all the space in the mold not occupied by solid impenetrable material.

To operate the mold shown in Fig. 5 the mold and its contents are heated, the plunger 42 removed, a proper quantity of insulation, preferably one of the commercial thermoplastic compounds, placed on the top of the core, and the plunger put in the mold on top of the compound. When the stored heat of the mold fluxes the compound the plunger is pressed downwardly to the position shown, the insulation allowed to harden after which the pulls 37 are withdrawn to leave the openings 52, and the armature is removed from the mold.

Fig. 7 is an axial section through the completed armature, the left side of the view being taken through one of the coil sides where it extends through a core slot as at 7—7 of Fig. 8 and the right side of the view being taken through one of the core teeth and between two coil sides as at 7′—7′ of Fig. 8, thus cutting through a row of the openings 52.

From a consideration of Fig. 7 and the fragmentary section Figs. 8 and 9 it will be seen that there is one single continuous mass of insulation 53 extending through and about the coil sides in the slots, and through and about the winding heads, forming the perforated cylinder 54 which has the integral wedge shaped spokes extending radially between the core sections, these spokes serving also as spacers for the core sections and as coverings for the otherwise unsupported parts 56 of the coil sides which bridge the gaps between the several core sections.

Flanges 57 are placed in the ends of the armature to support it concentrically on the shaft 58. A nut 59 draws the two flanges together. A key 61 provides driving relations between the shaft 58 and the one flange 57, while pins 62 provide driving relation between the flange and the armature. Openings 63 through the flanges admit air or other cooling medium into the space between the flanges.

The advantages of the structure are obvious, for while a large number of openings extend outwardly through the core and windings whereby rotation of the armature gives adequate ventilation the entire winding is at the same time imbedded and encased in an impervious insulation mass whereby the armature is adapted to situations where the air available as a cooling medium contains a large percentage of dust, moisture, acid fumes or other substances destructive to the ordinary exposed or inadequately insulated windings. The armature shown is of course particularly adapted to be used with a stator element which is similarly treated, but it may be used with any stator which is arranged as not to obstruct the outward passage of the cooling medium through the ducts. The

principle of my invention is of course also applicable to any stationary electromagnetic structure by providing means to move the cooling medium through the ventilating openings.

While I have indicated a preferred kind of insulation and a preferred procedure for applying it, any kind of insulation which can be made to penetrate the winding and form an impervious coating thereabout may be applied in the manner indicated or it may be applied by any other series of steps suitable to the nature of the insulation used, and when so applied will be considered as coming within the spirit of the invention, to specifically define which—

I claim,

1. The combination in an electromagnetic structure of a core comprising spaced apart sections, a winding on said core, and a single mass of insulation penetrating and completely covering the entire winding and filling the space between the core sections, there being a plurality of ventilating openings through the mass between the said core sections.

2. The combination in an electromagnetic structure of a core comprising spaced apart sections, a winding on said core, and a single mass of insulation penetrating and completely covering the entire winding and filling the space between the core sections, said mass having a plurality of ventilating openings extending therethrough between the coils where they extend across the space between the core sections.

3. The combination in a dynamo electric machine element of a slotted core with a central opening, said core being in spaced apart sections, and an integral mass of insulation extending through the slots of said core and filling the space between the core sections, the part of the mass between the core sections having a plurality of ventilating openings extending through the mass from said central opening outwardly.

4. The combination in a dynamo electric machine element of a core having a central opening, said core being in spaced apart sections, and a single mass of insulation forming a lining for said central opening with spokes extending outwardly into the space between the said sections.

5. The combination in a dynamo electric machine element of a core composed of laminæ having winding slots and a central opening, said laminæ being arranged in groups to compose spaced apart core sections, coils in said slots extending across the spaces between said core sections and forming coil heads at the outer ends of the core, and a single mass of insulation penetrating and surrounding the winding heads, lining the central opening of the core and extending outwardly between the core sections and lengthwise through the core slots, said mass having a plurality of radial ventilating openings extending between the coils where they extend across the space between the core sections inwardly through said lining.

6. The combination in a dynamo electric machine element having a central opening, of a core comprising a plurality of slotted laminæ arranged in spaced apart core sections, coils comprising a plurality of insulated wires in the slots of said core extending across the spaces between said core sections, and a single piece of insulation comprising a cylindrical lining for the central opening and a plurality of radial spokes extending from said lining between the core sections, the coil sides where they extend between core sections being imbedded and completely enclosed in the outer ends of said spokes.

7. The combination in a dynamo electric machine element having a central opening, of a core comprising a plurality of slotted laminæ arranged in spaced apart core sections, coils comprising a plurality of insulated wires in the slots of said core extending across the spaces between said core sections and an integral mass of insulation penetrating and completely surrounding the winding and extending within and between the core sections, said mass having a plurality of radial ventilating openings extending from the outer diameter of the element into the central opening, said ventilating openings being arranged in circular rows, one row in each space between core sections and the several openings of each row being between adjacent coil sides where they extend across the open spaces between core sections.

8. The method of making a ventilated electro-magnetic structure which consists of assembling a plurality of laminæ of magnetizable material in groups, spacing apart the groups to form a core, placing a winding on the core, placing a spaced apart row of pulls between each group, pressure molding a mass of insulation into and about the coils, about the core, and between the pulls in the spaced apart core sections, hardening the insulation, then removing the pulls to form a spaced apart row of ventilating ducts between each said pair of spaced apart core sections.

9. The method of making a ventilated dynamo electric machine element, which consists of building up a magnetizable core in spaced apart sections, from annular laminæ having circular rows of winding apertures, placing coils on said core with the coil sides in said apertures and extending across the spaces between the sections, placing a plurality of wedge shaped pulls in circular rows between the spaced apart sections, each pull being between and spaced slightly away from adjacent coil sides where they cross the spaces between said sections, molding a mass of insulation through and about the core, the coils

and the pulls, hardening the insulation, then removing the pulls.

10. A dynamo electric machine element comprising a core, a winding on said core having an annular winding head extending axially beyond one end of said core, two collector rings concentrically located within said annular winding head spaced apart from said head, from each other and from the core, ends of said winding being electrically joined one end to each collector ring, and an integral mass of insulation molded through and about said core, said winding head and said collector rings, said insulation mass constituting the sole support for said collector rings.

In testimony whereof I affix my signature.

VINCENT G. APPLE.