Aug. 11, 1925. 1,549,525

W. H. COONEY

SPACER FOR TRANSFORMER DISK COILS

Filed Dec. 31, 1924

Fig. 1.

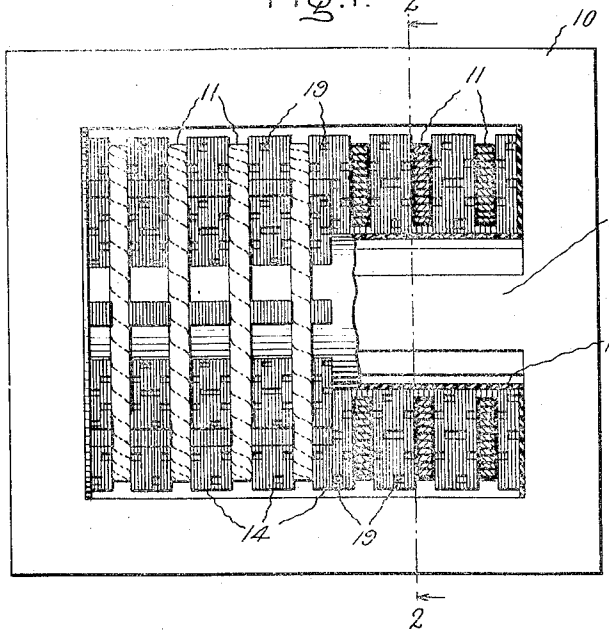
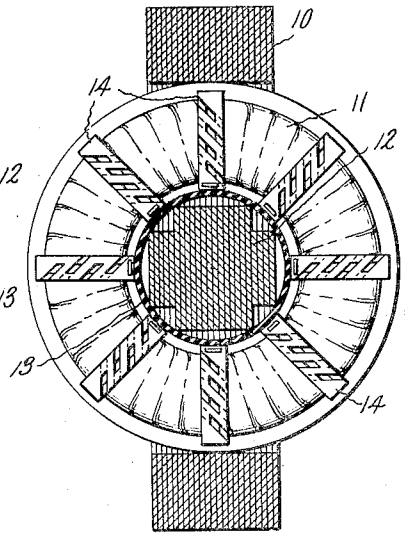


Fig. 2.



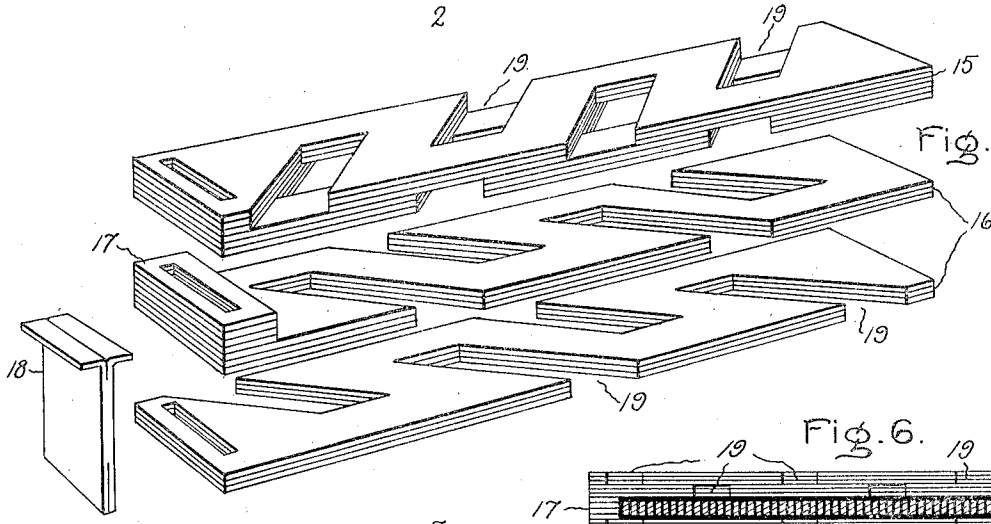


Fig. 3.

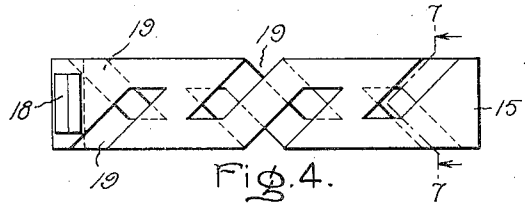


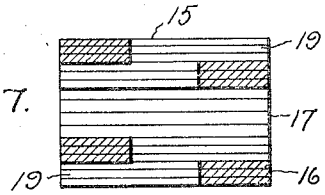
Fig. 4.
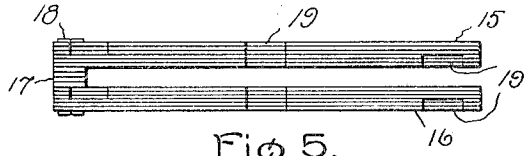


Fig. 5.

Fig. 6.

Fig. 7.



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Patented Aug. 11, 1925. 1,549,525

UNITED STATES PATENT OFFICE.

WILLIAM H. COONEY, OF PITTSFIELD, MASSACHUSETTS, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

SPACER FOR TRANSFORMER DISK COILS.

Application filed December 31, 1924. Serial No. 759,211.

To all whom it may concern:

Be it known that I, WILLIAM H. COONEY, 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 Spacers for Transformer Disk Coils, of which the following is a specification.

My invention relates to spacers for transformer disk coils. A transformer winding is with advantage often built up in the form of a stack of series connected annular shaped or disk coils and such coils are commonly separated by radial spacing strips to provide spaces or ducts between the coils for the circulation of an insulating and cooling fluid. The general object of the present invention is to provide an improved radial coil spacer having ducts adapted to permit free and efficient circulation of the cooling fluid.

The invention and its advantages will be better understood from the following description taken in connection with the accompanying drawing, in which Fig. 1 is a view in elevation of a transformer having coil spacers constructed in accordance with the invention, a portion of the transformer being broken away to reveal details; Fig. 2 is a view on the line 2—2 of Fig. 1 and in the direction of the arrows; Fig. 3 is a perspective view of one of the spacing units of Figs. 1 and 2, parts of the unit being separated to make its construction more clear; Fig. 4 is a face view of a modified form of spacing unit; Fig. 5 is an edge view of the spacing unit shown in Fig. 4; Fig. 6 is a view showing another modified form of spacing unit; and Fig. 7 is an enlarged sectional view on the line 7—7 of Fig. 4 and in the direction of the arrows.

Like reference characters indicate similar parts in the different figures of the drawing.

The transformer shown in Figs. 1 and 2 comprises a three-legged shell type core 10 with windings 11 on the central leg 12. The windings 11 comprise coils of the disk type which may be suitably connected in any desired manner as interleaved primary and secondary coils. The coils are supported and spaced axially around the winding leg 12 of the core by an insulating cylinder 13.

The coils 11 are maintained in spaced relation along the winding leg 12 by radial spacers 14, thus providing spaces or ducts between the coils for the circulation of a suitable cooling fluid in contact with the opposed coil surfaces. In order to show the construction more clearly, the thickness of the radial spacers 14 is exaggerated somewhat in Fig. 1 as compared with the thickness which would ordinarily be desirable for spacing the coils 11.

In forming the spacers 14 shown in Figs. 1, 2 and 3, U-shaped spacing units are used, each unit comprising two parallel side members 15 and 16 separated or spaced apart by a short base member 17 secured between them at one end. These U-shaped units are built up of sheets of suitable insulating material such as pressboard. The thickness of the space between the side members 15 and 16 is the same as that of a coil 11 which it is to receive and this thickness is determined by the thickness of the base member 17. The U-shaped spacing unit is thus adapted to fit over the two faces and one edge, preferably the inner edge, of a coil and the side members 15 and 16 are preferably of such length that their free ends extend as far as or slightly beyond the other edge of the coil as indicated in Figs. 1 and 2. The several layers of insulating material forming a spacing unit are secured together by a short securing strip 18 extending through aligned openings in the layers, the ends of the securing strip being split and bent over to hold it in place. Fig. 3 shows this securing strip removed and the layers of the spacing unit separated into three groups to reveal the construction more clearly.

Each coil 11 is provided with a plurality of radially arranged spacing units and the inner edge of each coil is spaced a short distance from the insulating cylinder 13 to accommodate the base members 17 of the spacing units. The spacing units on the several coils are arranged in the same angular positions around the winding leg 12 of the core so that their adjacent side members are in contact one with the other between the coils as indicated in Fig. 1. Each spacer 14, therefore, consists of one side member of one spacing unit on one coil and the adjacent side member of another spacing unit on the next coil, these two side members being superposed and their combined thickness determining the spacing or separation of the two coils.

Each side member of the U-shaped spac-

ing units is formed with transverse ducts 19 which provide communication between the two sector-shaped spaces at its opposite sides so that the cooling fluid between the coils is not trapped in these spaces or its circulation obstructed. This is of particular advantage in connection with coils which are arranged in vertical positions about a horizontal winding leg of a core as indicated in Figs. 1 and 2.

In accordance with the invention, the transverse ducts 19 in the side members of the spacing units are formed by notches extending in from the edges of the insulating sheets of material of which the side members are built up. Each side member of a spacing unit is substantially rectangular in cross section. Each transverse duct 19 is formed by two transverse notches extending in from two diagonally opposite longitudinal corners of a side member, the two notches communicating at their inner ends to form the single duct. The two ends of the duct open at each of the opposite edge surfaces of the side member to provide entrance and exit openings for insulating fluid and they also open at each face surface of the side member so that a coil in contact with either face surface of a side member may be in contact with and may be cooled by the fluid flowing through the duct. Where two side members are superposed to form a single spacer as shown in Fig. 1, each of the coils separated by the spacer is cooled by the fluid in the ducts of the adjacent side member. Another advantage of this form of transverse duct is that none of the layers of material in the spacer are severed by the duct, each layer being in one continuous piece throughout the length of the spacer. The single securing means 18 at the base or closed end of the spacer is therefore sufficient to secure the several layers together.

The conductor in the coils of course crosses the radial spacers approximately at right angles. The notches and ducts are therefore preferably disposed at acute angles to the edges of the spacers with the two ends of each notch respectively offset lengthwise of the spacer so that there may be solid support for every turn of the conductor in the coils.

The modified form of spacing unit shown in Figs. 4, 5 and 7 is similar to that already described except that the two notches forming each transverse duct 19 extend in different directions across the spacer instead of in the same direction.

The spacing unit shown in Fig. 6 is like that shown in Figs. 1, 2 and 3 except that it consists only of one side member 15 and a base member 17, the second side member of Figs. 1, 2 and 3 being omitted. Where this form is used, the separation or spacing of the coils 11 is equal to the thickness of a single side member of the spacing unit. A single side member therefore constitutes a spacer in this form and the fluid in each duct flows in contact with and cools the adjacent surfaces of both coils separated by the spacer, the fluid first flowing in contact with the surface of one coil and then crossing over to the other coil before leaving the duct.

The spacers which have been described are adapted to extend between the coils of a transformer winding to provide ventilating spaces for a suitable cooling fluid. Each side member of a spacer is rectangular in cross section and has transverse ducts extending in a general direction from one corner of the member to the diagonally opposite corner, the ducts opening upon all four faces of the member. The ducts thus furnish entrance and exit paths for a cooling fluid at two opposite faces of the member and bring the cooling fluid flowing in the ducts into contact with a coil surface which may lie against either of the other opposite faces. This form of transverse duct has the further advantage that it may be produced without severing any of the layers of material of which the spacer is built up, each layer being in a single piece throughout its length so that the parts of the spacer are not easily displaced.

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

1. A spacer for transformer coils, said spacer comprising a member adapted to extend between two adjacent coils, said member being substantially rectangular in cross section and having a transverse duct opening at all four faces of said member.

2. A spacer for transformer coils, said spacer comprising a member adapted to extend between two adjacent coils, said member being substantially rectangular in cross section and having a transverse duct extending through it in a generally diagonal direction from one longitudinal corner to the opposite longitudinal corner.

3. A spacer for transformer coils, said spacer being formed of a plurality of layers, part of said layers being notched at one face of the spacer and other layers being notched at the opposite face of the spacer, each notch communicating with a notch at the opposite face of the spacer to form a transverse duct for a cooling fluid.

In witness whereof, I have hereunto set my hand this 26th day of Dec., 1924.

WILLIAM H. COONEY.