W. KÖCHLING.

ELECTRICAL APPARATUS.

APPLICATION FILED MAY 22, 1915.

1,173,004. Patented Feb. 22, 1916.

Fig. 1.

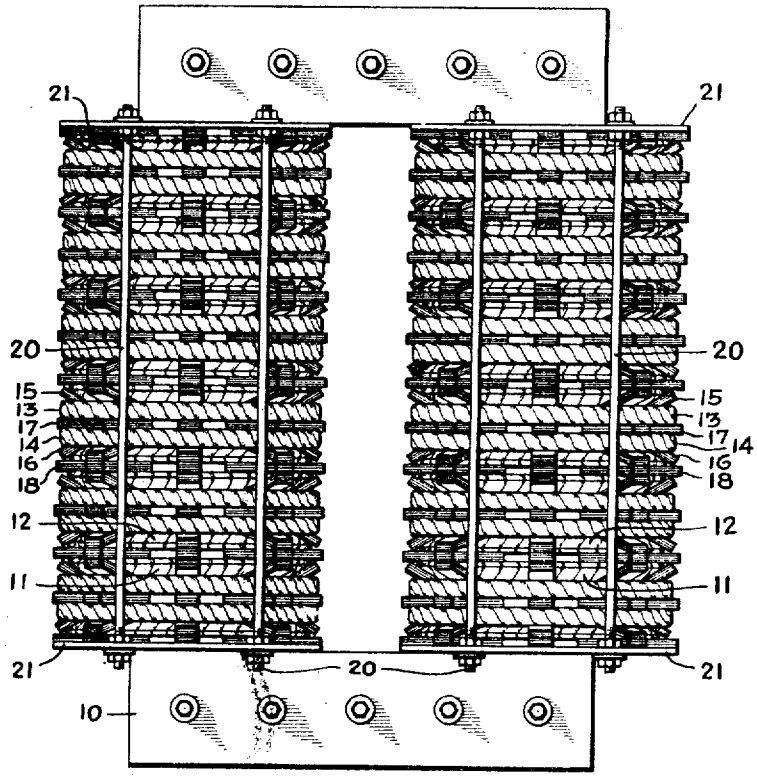
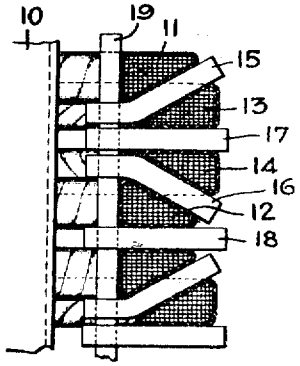


Fig. 2.



Witnesses:
Lester H. Palmer.
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UNITED STATES PATENT OFFICE.

WILHELM KÖCHLING, OF REINICKENDORF-OST, GERMANY, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

ELECTRICAL APPARATUS.

1,173,004. Specification of Letters Patent. Patented Feb. 22, 1916.

Application filed May 22, 1915. Serial No. 29,786.

To all whom it may concern:

Be it known that I, WILHELM KÖCHLING, a subject of the King of Prussia, residing at Reinickendorf-Ost, Germany, have invented certain new and useful Improvements in Electrical Apparatus, of which the following is a specification.

My invention relates to transformers, and to electrical windings adapted particularly for use in transformers.

The object of my invention is to improve the ventilation of disk coil windings and transformers, using the term disk coil broadly.

The advantages of disk coil windings and transformers are well known; however, one of the disadvantages of this type of apparatus, particularly noticeable in disk coil core type transformers as heretofore commonly constructed and cooled, is that the insulating and ventilating spaces between the coils are substantially perpendicular to the axis of the winding, and hence to the general direction of the flow of the insulating and cooling fluid. In consequence the fluid does not naturally circulate readily through these spaces, and foreign matter is deposited therein. According to my invention, more or less of these spaces are inclined to the axis of the winding so that the fluid more readily flows through them. Preferably the coils are triangular in cross section and are arranged with the bases of the triangular cross sections of the low voltage coils at the interior of the winding, and with the spaces running in a zigzag course into and out of the winding; that is, so that the passages or spaces are inclined alternately inwardly and outwardly, offering the fluid a plurality of points of admission to and exit from the winding. Various modifications of this construction may be made, however, without departing from my invention.

In the accompanying drawings and the following description, I have illustrated and described in detail a preferred embodiment of my invention.

Figure 1 is an elevation of a transformer embodying this construction, and Fig. 2 is an enlarged sectional view of a part of the transformer of Fig. 1 illustrating certain details.

In the transformer of Fig. 1 the core 10 is the ordinary two-legged core of the common core type transformer. As may be understood from Fig. 1, and as is more apparent from Fig. 2, the coils of this transformer are disk coils within the broad meaning of that term, and are solid as heretofore, that is, are so constructed as to substantially prohibit the flow of the cooling fluid through any one coil between the turns thereof. They resemble concentric coils more or less in some of their features however. The cross section of each of the coils is generally a right angle triangle, and the low voltage coils 11, 12, etc., are so arranged that the bases of the triangular cross sections are at the interior of the winding. The high voltage coils 13, 14, etc., are arranged with the bases of their triangular cross sections at the exterior of the winding, thus following the usual practice of placing the low voltage coils more closely to the core than the high voltage coils.

The coils 13, 14, etc., are alternately reversed with respect to each other, that is the inclined face of coil 13 is above and the similar face of 14 is below. The coils 11 and 12 are likewise reversed, and the coils are assembled so that each inclined face is opposite another inclined face. The coils are separated at the inclined faces by the spacers 15, 16, etc. Thus the inclined ventilating spaces or passages within the winding are provided. The winding is spaced some distance from the core, providing a ventilating space between the core and coils. The adjacent high voltage coils as 13 and 14, and the adjacent low voltage coils as 11 and 12, are separated by the spacers 17 and 18, and the spaces thus formed are perpendicular to the axis of the winding since the coil cross sections are right angle triangles. The spacers are held in position by the rods 19 extending parallel to the winding axis and within the coils. The rods 20 and plates 21 bind the coils solidly together.

Supposing the transformer illustrated is to be cooled by the natural draft of the cooling fluid (air, oil, or any other suitable fluid), the transformer is installed in the position illustrated in Fig. 1, and the cooling fluid flows upward in the space between the core and the coils, and also naturally tends to flow across one (inclined) face of each coil, flowing inward between such coils as 12 and 14, and flowing outward between such coils as 11 and 13. The passage thus

formed by the ventilating spaces between the coils is a zigzag one, and there are a plurality of spaces for admitting the fluid into the interior of the winding and a plurality of spaces allowing its exit therefrom, thus efficiently cooling both the coils and core.

While I have described the principle of my invention and the best mode I have contemplated for applying this principle, other modifications will occur to those skilled in this art and I aim in the appended claims to cover all modifications which do not involve a departure from the spirit and scope of my invention.

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

1. A transformer comprising a core and a winding surrounding said core, said winding comprising layers of solid high voltage and low voltage coils of substantially triangular cross-section, the bases of the triangular cross-sections of the low voltage coils being at the interior of the winding and the bases of the triangular cross-sections of the high voltage coils, spaced therefrom, being at the exterior of the winding, providing a zigzag insulating and cooling passage between the coils.

2. An electrical winding comprising solid coils of substantially triangular cross-section, the apexes of the cross-sections of some of said coils extending outwardly and the apexes of adjacent coils, spaced therefrom, extending inwardly providing a zigzag insulating and cooling passage between coils.

3. A transformer comprising a core a a winding surrounding said core and tending vertically, said winding comprisi a plurality of stationary solid disk cc with adjacent faces of adjacent coils clined to the vertical and spaced apart form ventilating passages.

4. A transformer comprising a core an winding surrounding and separated fr said core, said winding comprising a p rality of stationary solid disk coils havi faces inclined to the axis of the windi spaced apart to form ventilating passage

5. An electrical winding comprising plurality of solid disk coils stationary w respect to each other having faces incli to the axis of the winding spaced apart form ventilating passages in the windin

6. An electrical winding provided w ventilating spaces parallel to the axis and within and without, said winding, other ventilating spaces inclined to the a of the winding extending through s winding and connecting said first mentio spaces.

In witness whereof, I have hereunto my hand this 7th day of April, 1915.

WILHELM KÖCHLING

Witnesses:
RICHARD NEUMANN,
BRUNO FREUDENHAMMER.