Dec. 30, 1947. J. C. GRANFIELD 2,433,660

CORE FOR ELECTRICAL DEVICES

Filed Oct. 18, 1946

Fig. 1

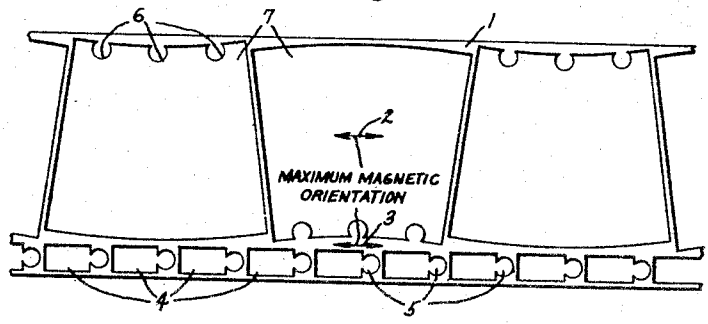


Fig. 2

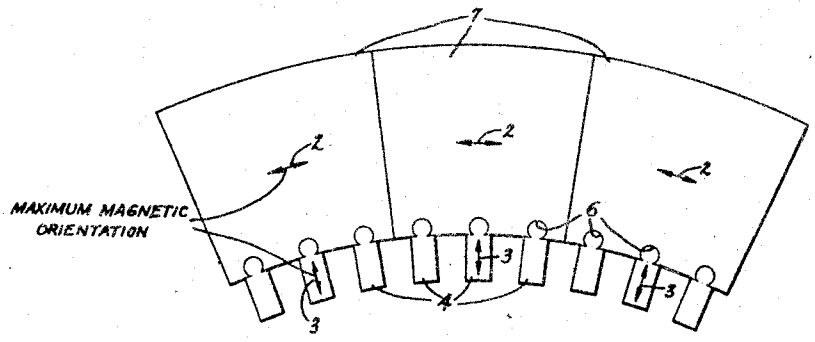


Fig. 3

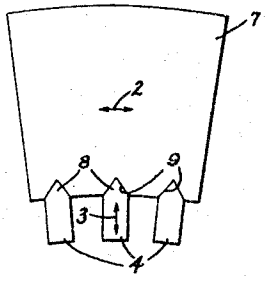
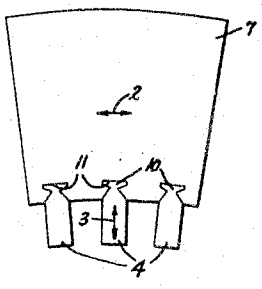


Fig. 4



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Patented Dec. 30, 1947

2,433,660

UNITED STATES PATENT OFFICE

2,433,660

CORE FOR ELECTRICAL DEVICES

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Application October 18, 1946, Serial No. 703,928

6 Claims. (Cl. 171—252)

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My invention relates to laminated cores for electrical devices.

In cores for electrical devices, such as dynamoelectric machines, in which windings are placed in slots in the surface of the core, the flux in the teeth on the sides of the winding slots is subjected to high frequency pulsations caused by relative movement of teeth of the core on an adjacent member. These flux pulsations cause a tooth tip core loss which forms a substantial part of the total core loss of such a device. In analyzing the core losses of such devices, attention must be given both to the losses due to eddy currents caused primarily by high frequency pulsations and also to hysteresis losses due primarily to low frequency pulsations. The effect of grain structure on the high frequency core losses was not indicated in Epstein tests as formerly conducted, because in such tests, one-half the iron to be tested is arranged so that flux passes across the grain and the other half of the iron is arranged so that the flux passes with the grain of the material. At present, special provision is made for material to be used with flux in one direction relative to the direction of rolling. It has been found that if the grain structure of the ferro-magnetic material is not elongated but is more nearly equiaxed, the high frequency tooth tip core losses of laminations are lowered, even though the Epstein test does not indicate that this reduction should be expected. The characteristics obtained by an elongated grain structure are particularly pronounced in cold rolled ferro-magnetic material and may be called the magnetic orientation properties of the material. This magnetic orientation also includes the crystalline arrangement and has been discussed in detail in U. S. Patent 2,053,162 to R. M. Pfalzgraff and in U. S. Patent 2,276,793 to D. C. Prince.

An object of my invention is to provide improved cores for electrical devices having low core losses and improved magnetic properties

Further objects and advantages of my invention will become apparent and my invention will be better understood from the following description referring to the accompanying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

In the drawing, Fig. 1 is a fragmentary plan view of a strip of ferro-magnetic material with punchings from which a core for an electrical device, such as a dynamoelectric machine may be made in accordance with an embodiment of my

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invention; Fig. 2 illustrates a part of a core of an electrical device made from the punchings shown in Fig. 1; Fig. 3 illustrates a part of a core including another embodiment of my invention; and Fig. 4 illustrates a part of a core provided with a further embodiment of my invention.

Referring to the drawing, Fig. 1 illustrates a strip 1 of ferro-magnetic material which has been cold rolled to produce a maximum magnetic orientation resulting in a crystalline formation and an elongation of the granular structure of the material which extends substantially longitudinally of the strip, as indicated by the arrows 2 and 3 in this figure. In certain types of electrical devices, such as large dynamoelectric machines, formed with cores of ferro-magnetic material, the cores generally are laminated in order to minimize eddy current losses therein and are assembled from a plurality of segments arranged to provide the desired core assembly. The magnetic properties of such cores are improved and the core losses reduced as explained above when the maximum magnetic orientation is in the direction of the magnetic excitation flux paths through the material. Since the teeth in such equipment are generally arranged substantially transversely to the major core portion, it is desirable that the toothed portions of the core should be made separate from the remainder of the core in order to provide both parts of the core with the most desirable magnetic properties. In the construction illustrated in Figs. 1 and 2, the core of the device, such as a dynamoelectric machine, is adapted to be punched from a longitudinally extending strip 1 and comprises a plurality of individual teeth 4 formed with dovetailed connecting ends 5 which are adapted to secure the teeth 4 by individual mechanical engagement with complementary dovetail openings 6 formed in an edge of arcuate segments 7 adapted to be arranged as shown in Fig. 2 to form the major portion of the core of the machine. As shown in Fig. 1, a very efficient utilization of the ferro-magnetic strip material may be realized by punching the core segments 7 from one side of the strip 1 with the maximum magnetic orientation of the material in a direction substantially longitudinally of the core formed by the segments 7 and punching the teeth 4 from the other edge of the strip material 1 in such relation that the maximum magnetic orientation of the material is substantially longitudinal of the teeth. Thus, a completed core for the device is formed in which a maximum magnetic orientation extends substantially longitudinally of each portion of the core formed by

the arcuate segments 7 and the teeth 4. In the type core illustrated in Fig. 2, the maximum magnetic orientation of the segments 7 when assembled is substantially transverse of the teeth 4 which is the direction in which the magnetic excitation flux paths normally take in this portion of the core, and thus this core arrangement provides for the maximum utilization of the magnetic orientation effects in the cold rolled ferromagnetic material.

In Fig. 3, I have shown another embodiment of my invention which is adapted to be formed in substantially the same manner as that disclosed in Fig. 1, and the tooth portions 4 are formed with mitered ends 8 which extend into circumferentially spaced complementary openings 9 formed in an edge of the arcuate segments 7 similar to the dovetailed ends and openings in the construction shown in Figs. 1 and 2. This arrangement has the advantage that the magnetic flux paths take substantially exactly the arrangement of the grain structure in the teeth 4 and the segments 7. A core assembly may be formed of this construction in the same manner as that described with reference to Figs. 1 and 2, and the arrows in this figure also indicate the direction of maximum magnetic orientation for the parts as in Figs. 1 and 2. This construction, however, requires a special securing device at the ends of the core for retaining the segments and teeth in assembled relationship which is more complicated than that required for a core constructed with dovetailed joints as shown in Fig. 2.

In Fig. 4, I have shown a further modification of my invention in which the teeth 4 and the core segments 7 may be formed in the same manner as that disclosed in Fig. 1, and the teeth are provided with anchoring dovetailed portions 10 arranged in engagement with complementary dovetail openings 11 in the segments 7 for individually securing the teeth 4 in position on the segments 7. This assembly is similar in other respects to that shown in Fig. 2 and utilizes the desirable effects of the arrangement of the maximum magnetic orientation of the ferromagnetic material in the same manner as that shown in Fig. 2 and as also indicated by the double-headed arrows 2 and 3.

While I have illustrated and described particular embodiments of my invention, modifications thereof will occur to those skilled in the art. I desire it to be understood, therefore, that my invention is not to be limited to the particular arrangements disclosed and I intend in the appended claims to cover all modifications which do not depart 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 core of ferro-magnetic material for electrical devices including a portion formed of individual teeth comprising material having maximum magnetic orientation substantially longitudinally of said teeth, and a core portion connected to said individual teeth and comprising material having maximum magnetic orientation substantially transversely of said teeth.

2. A core of cold rolled ferro-magnetic material for dynamoelectric machines including a portion formed of individual teeth comprising material having an elongated grain structure extending longitudinally of said teeth, and a second core portion connected to said individual teeth and comprising material having an elongated grain structure extending substantially longitudinally of said second core portion and transversely of said teeth.

3. A core of ferro-magnetic material for electrical devices including a portion formed of individual teeth comprising material having maximum magnetic orientation substantially longitudinally of said teeth, and a second core portion having mitered joints connecting said individual teeth to said second core portion and comprising material having maximum magnetic orientation substantially transversely of said teeth.

4. A core of cold rolled ferro-magnetic material for dynamoelectric machines including a portion formed of individual teeth comprising material having an elongated grain structure extending longitudinally of said teeth, and a second core portion connected along one edge by dovetailed joints to said individual teeth and comprising material having an elongated grain structure extending substantially longitudinally of said second core portion and transversely of said teeth.

5. A core of ferro-magnetic material for electrical devices including a portion formed of individual teeth each having a dovetailed portion and comprising material having maximum magnetic orientation substantially longitudinally of said teeth, and a second core portion having openings complementary to said tooth dovetailed portions longitudinally spaced in an edge thereof arranged in engagement with said tooth dovetailed portions and comprising material having maximum magnetic orientation substantially transversely of said teeth.

6. A core of ferro-magnetic material for electrical devices including a portion formed of individual teeth each having a dovetailed portion at one end thereof and comprising material having maximum magnetic orientation substantially longitudinally of said teeth, and a second core portion formed of arcuate segments having openings complementary to said tooth dovetailed portions circumferentially spaced in an edge thereof and comprising material having maximum magnetic orientation substantially transversely of said teeth, said teeth being individually secured by said dovetailed portions in said openings extending substantially radially from said edge of said second core portion.

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REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,053,162	Pfalzgraff	Sept. 1, 1936
2,276,793	Prince	Mar. 17, 1942