

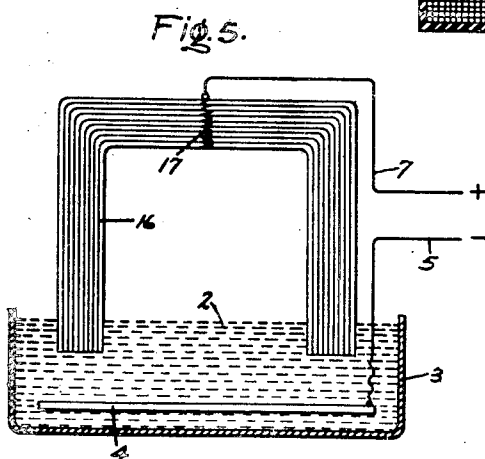
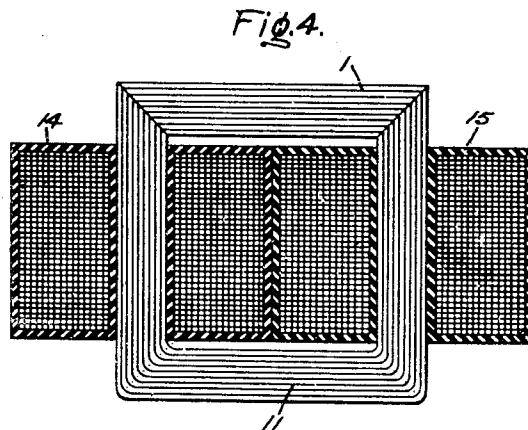
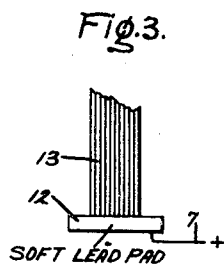
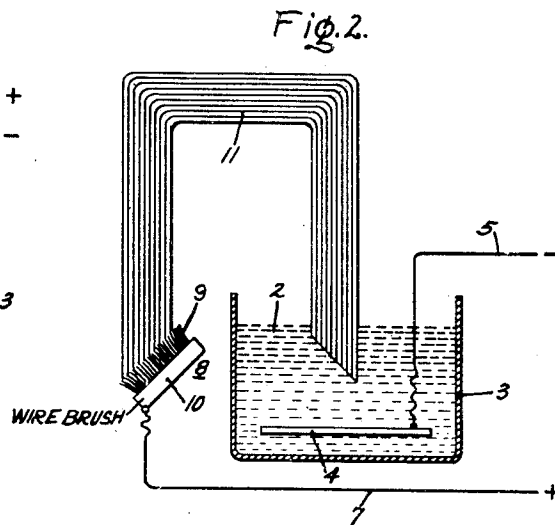
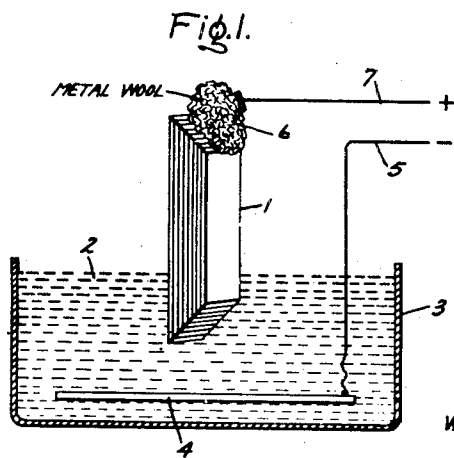
Aug. 16, 1949.

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2,479,302

METHOD OF ELECTROPOLISHING LAMINATED MAGNETIC CORES

Filed Oct. 11, 1945



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UNITED STATES PATENT OFFICE

2,479,302

METHOD OF ELECTROPOLISHING LAMINATED MAGNETIC CORES

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Application October 11, 1945, Serial No. 621,743

1 Claim. (Cl. 204—140)

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This invention relates to magnetic cores for electromagnetic induction apparatus and more particularly to improvements in the electrolytic polishing of the faces which form butt joints in such cores.

Butt joints in closed magnetic cores are often used so that a preformed coil or coils can be slipped over the winding leg or legs of the core by separating the core at its butt joint or joints. In order to reduce the magnetizing current and losses of the apparatus it is ordinarily desirable that the butt joints have minimum reluctance or air gap effect. The faces forming the butt joints are therefore ground or machined as smooth as possible. However, this mechanical polishing unavoidably produces minute sidewise extended burrs or sharp projections on the edges of the individual laminations and these projections bridge across and short circuit the insulation between adjacent laminations, thereby materially increasing the eddy current component of the core loss.

One way of removing such burrs is by the so-called electrolytic polishing method. This is the reverse of electroplating and is characterized by making the face to be deburred or polished the anode, instead of the cathode, in an electrolyte. The electrolyte is usually an acid solution which is either so concentrated or else so dilute that no removal of metal by straight chemical action or etching takes place in the short time required for the electrolytic action. The principle of the electrolytic action is that a film—such as a layer of gas, or a layer of liquid highly concentrated in the anode material, or of insoluble salt—forms across the surface of the anode. This film offers high resistance to the flow of current but it is thinnest at the corners or on any sharp projections or edges so that the current density is highest at these points and hence they are electrolytically dissolved fastest.

From the above it will be seen that it is essential for the success of the electrolytic method that current must flow through each and every lamination. In other words, for current to leave each lamination at the core face which is to be polished and enter the electrolyte it is necessary to make positive electrical contact or connection with each lamination at some place other than that face so that the current can enter each lamination. Because of the fact that the laminations are separated by insulation or low conductivity material such connection cannot be made by a simple clip as in ordinary electroplating or electrolytic polishing of solid metal objects.

Heretofore such contact or connection has

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been made by means of a separate body of electrolyte similar to the one in which the polishing action takes place. The other face of the core part is immersed in this second body of electrolyte, electrical connection to the two bodies of electrolyte being made by separate electrodes therein and the circuit between the separate liquid bodies being completed through the core part. This has numerous disadvantages. In the first place, it is only applicable to core parts which are curved or angular, whereas frequently it is desirable to have straight yoke or leg parts with smooth worked ends. In the second place, an electroplating action will take place at the face which is a cathode with respect to its immersing electrolyte, which obviously is the reverse of the action desired and which makes it take longer subsequently electrolytically to polish that face. In the third place, the electrolytic action taking place in the second body of electrolyte doubles the amount of gases and fumes which are given off in the process, and as these fumes are usually noxious and sometimes even toxic, such increased production of fumes is highly undesirable. In the fourth place, the electrode in the second body of electrolyte by which external electrical connections are made is an anode with respect to its electrolyte and therefore it will be eaten away by the passage of current there-through so that it will periodically have to be replaced, which is of course an additional item of expense.

While some of these disadvantages can be overcome by the use of a conducting liquid, such as mercury, for the second body of electrolyte, not all of them can and it would still be impossible to polish straight core parts.

Electrical connection to the laminations by solid contact with a flat plate of ordinary low resistance conducting metal is not practical because of the difficulty of insuring adequate and uniform contact between each lamination and the metal member even when the latter is a polished flat surface.

In accordance with this invention the electrical connection to the core part having a face to be electrolytically deburred or polished is made by means of a special dry solid contact member which has the property of insuring good electrical contact with each and every lamination. In one form it may be a yielding metallic member, such as a pad of metal wool or a brush of fine, sharp, pointed wires or a pad of soft lead. Such metal member is pressed against the edges of the laminations, preferably on the other

smooth worked face of the core part, and in this way positive low resistance electrical connection is insured to each of the laminations. In another form it may be a weld across the edges of the laminations which weld also serves the purpose of holding the laminations together.

An object of the invention is to provide a new and improved method of electrolytically polishing the butt joint forming faces of laminated magnetic core parts.

Another object of the invention is to provide a new and improved method of making electrical connection to each and every lamination of a laminated core part during electrolytic polishing of a face thereof.

The invention will be better understood from the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claim.

In the drawing Fig. 1 illustrates the practicing of the invention with a pad of metal wool, such as steel wool, Fig. 2 shows a modification in which a wire brush is used, Fig. 3 is another modification in which a soft lead pad is used, Fig. 4 is a view of an assembled core and coils having mitered butt joints between a U-shaped core part having two winding legs and a straight yoke part, and Fig. 5 is a further modification in which a weld across the edges of the laminations is used.

Referring now to the drawing and more particularly to Fig. 1, there is shown therein a straight laminated magnetic core part 1 having a pair of beveled end faces which are to form parts of mitered butt joints in a closed magnetic core. These faces have previously been mechanically smooth worked in a well-known manner. Such mechanical working invariably results in minute burrs which short circuit the laminations. One face or end of the part 1 is immersed in a body of electrolyte 2 which is confined in a suitable container 3. Any suitable electrolytic polishing solution may be used and one common one consists mainly of phosphoric acid, with lesser amounts of other materials such as sulfuric acid, perchloric acid, citric acid, glycerol, methyl alcohol, etc. Electrical connection to the electrolytic solution 2 is made by means of an electrode 4 which is immersed in the solution and which is connected by means of a lead 5 to the negative side of a suitable source of unidirectional potential (not shown).

Electrical connection between the other or positive side of the source of potential is made by means of a pad 6 of mineral wool, such as steel wool, which is pressed against the edges of the laminations forming the core part 1 and which is connected to the positive side of the source of potential by means of a lead 7, one end of which is embedded in the pad 6. The pad 6 is preferably pressed against the opposite face of the core part 1 as that face having been ground or machined smooth will ordinarily be cleaner and have less oxide or other low conductivity material on the edges of the laminations.

Fig. 2 shows the use of a brush 8 having a large number of fine, sharp, pointed wire bristles 9 attached to a metal backing plate 10. The bristles of the brush are preferably pressed against one face of a core part which in Fig. 2 is indicated as being a U-shaped part 11, the other face of which is embedded in the electrolyte 2. The spacing between the bristles is small in comparison with

the dimensions of the laminations, and as the bristles have a relatively large amount of spring or give, contact is assured with each lamination. Furthermore, the sharp points of the wires tend to penetrate any oxide film or other material on the edges of the laminations and thus good electrical contact is insured.

In Fig. 3 a soft lead pad 12 is used as the mechanical contacting material and this is shown pressed against a square face of a core part 13, only part of which is shown. By applying sufficient pressure the lead will yield or flow sufficiently to insure actual mechanical, and therefore electrical, contact with each lamination.

Fig. 4 shows how core parts 1 and 11 of Figs. 1 and 2 respectively may be combined with coils 14 and 15 so as to provide a complete electrical induction apparatus, such as a transformer.

In the modification shown in Fig. 5 a core part 16 has all of its laminations on one side electrically connected together by a line or arc weld 17. The positive lead 7 can therefore easily be connected to each lamination by way of this weld. As the weld is on only one side of the core a circuit for eddy currents is not completed. This procedure has the advantage that when the core part is nonlinear both its faces can be electrolytically polished simultaneously, as shown in Fig. 5. The weld 17 also serves as a mechanical bond for holding the laminations together. As the weld is made by depositing molten metal it will be clear that electrical connection can also be made by other ways of depositing molten metal such as by soldering or brazing.

While there have been shown and described particular embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications can be made therein without departing from the invention and, therefore, it is aimed in the appended claim to cover all such changes and modifications as fall within the true spirit and scope of the invention.

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

The method of electrolytically polishing both end faces of a laminated generally U-shaped core part simultaneously which includes the steps of welding the edges of the laminations together on one side only of said core part substantially midway between said faces, immersing said faces in a suitable common body of electrolyte, connecting the positive side of a source of unidirectional potential to said core at said weld, and connecting the negative side of said source to an electrode in contact with said electrolyte.

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