G. W. ELMEN.

MAGNET CORE.

APPLICATION FILED APR. 2, 1918.

1,297,127. Patented Mar. 11, 1919.

Fig. 1.

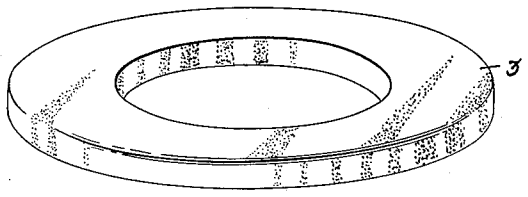
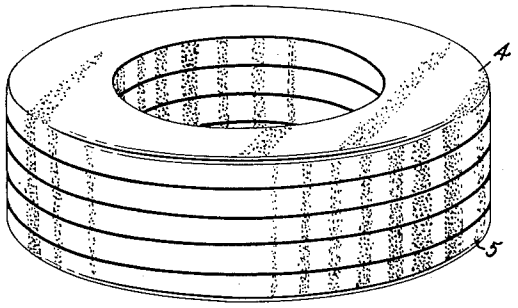


Fig. 2.



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UNITED STATES PATENT OFFICE.

GUSTAF W. ELMEN, OF BOGOTA, NEW JERSEY, ASSIGNOR TO WESTERN ELECTRIC COMPANY, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

MAGNET-CORE.

1,297,127. Specification of Letters Patent. Patented Mar. 11, 1919.

Application filed April 2, 1918. Serial No. 226,284.

To all whom it may concern:

Be it known that I, GUSTAF W. ELMEN, a citizen of the United States, residing at Bogota, in the county of Bergen, State of New Jersey, have invented certain new and useful Improvements in Magnet-Cores, of which the following is a full, clear, concise, and exact description.

This invention relates to magnet cores generally and particularly to cores for loading coils for telephone circuits. Its general object is to provide a new and improved core material which is cheap to manufacture, which is easily formed into the desired shape, and which possesses to a high degree those characteristics most advantageous in cores for loading coils and other electrical apparatus.

The present invention relates to the same general type of magnet cores as those described and claimed in the following applications for Letters Patent for improvements in magnet cores, namely: Serial No. 89,409, filed April 6, 1916, in the name of James Buckner Speed; Serial No. 89,467, filed April 6, 1916, in the name of the present applicant; Serial No. 100,056, filed May 26, 1916, in the name of John C. Woodruff, for improvements in magnet cores; and Serial No. 226,283, filed April 2, 1918, in the name of the present applicant, all of which applications are assigned to the same assignee as the present application.

The above identified applications describe magnet cores and particularly loading coil cores composed of finely divided magnetic material and insulating material separating the particles of magnetic material, said compound being compressed into a self-sustaining solid body by subjecting the mass to pressure sufficient to give it a specific gravity approximately the same as the specific gravity of the undivided magnetic material, and probably sufficient to distort some at least of the magnetic particles beyond their elastic limits. In the Speed application above mentioned, iron-by-hydrogen is referred to as a suitable magnetic material; and in the Woodruff and Elmen applications, finely divided electrolytic iron is specified; while the last Elmen application, Serial No. 226,283, refers to a mixture of particles of unannealed electrolytic iron with particles of softer magnetic material.

The present invention is the result of the discovery that a properly prepared magnetic alloy may advantageously be substituted for the hard electrolytic iron described in said last named application. This invention, therefore, relates to a magnet core characterized by the use of a finely divided magnetic alloy such as ferro-silicon.

In the drawing, Figure 1 is a perspective view of a section of loading coil made in accordance with the present invention; and Fig. 2 shows a plurality of these sections assembled to form a complete core. It will be understood, however, that this is merely illustrative, and that the invention is not limited to the production of this form of core, but is adapted to the making of cores of many forms.

In accordance with the present invention, a brittle magnetic alloy is formed, preferably by fusing iron and then adding thereto eight per cent. or more of silicon, and then rapidly cooling the molten alloy by pouring it into cool molds, or spreading it in a thin layer over a suitable floor. This results in a very brittle substance which may readily be reduced to a finely divided form by breaking the cast mass into small pieces and grinding them in a ball mill. Experience shows that for the best results in core making the particles used should not be larger in size than what will pass through an 80-mesh screen.

The preferred method of forming the finely divided alloy into magnetic cores is similar to that employed when unannealed electrolytic iron is used, as set forth in Elmen application, Serial No. 226,283, above referred to. But in order that this application may contain a full disclosure relative to the present invention, the steps of this method will now be set forth.

The finely divided alloy is mixed with from five to ten per cent. or more of finely divided relatively soft magnetic material such as iron-by-hydrogen or annealed electrolytic iron. The latter material is readily obtained by annealing in a suitable furnace ground electrolytic iron produced by grinding in a ball mill electrolytic iron obtained, for example, from a cell containing a bath of ferrous ammonium sulfate.

The hard alloy and softer iron particles are thoroughly intermixed so that the iron particles are distributed evenly throughout the mass of hard alloy. Before or after the

intermixing the particles of both materials are individually insulated. This may be accomplished by producing a surface coating of red iron oxid on each particle, as by adding to a mass of iron particles approximately ten per cent. by weight of water and then heating and stirring the mixture in the presence of air until dried. A preferred method is that set forth in Woodruff application, Serial No. 100,056, above referred to, and consists in giving each particle a zinc coating by mixing the iron particles with pieces of zinc and tumbling the mixture in a drum for several hours; to the mass of zinc-coated particles is added a thin solution of insulating material such as shellac, and the mixture is stirred until the surfaces of the zinc-coated iron particles are thoroughly covered with shellac, after which the alcohol of the shellac solution is evaporated from the mixture by a suitable method, such as slowly tumbling the mass in a tumbling barrel through which a current of air is drawn.

The mixture of zinc and shellac-coated hard and soft particles is subjected, by means of suitable molds and presses, to a pressure of about 200,000 to 250,000 pounds per square inch. This probably results in distorting the softer particles of iron beyond their elastic limits so that they are caused, as it were, to interlock with the harder particles of alloy and bind the mass into a hard self-sustaining solid body having a specific gravity of 6.5 or higher, that is, approximately 7, and therefore about that of undivided ferro-silicon. The harder particles are probably not permanently changed in shape, although some of them may suffer fracture; but neither this nor the puncturing of the insulating coats of the particles occurs to a sufficient extent to materially decrease the electrical resistance of the mass.

In practice, it has been found desirable in making loading coil cores to use core sections having a thickness of about one-fifth of an inch and to use five or more sections in building up a core, a suitable insulating material such as paper, lacquer or shellac being interposed between the sections. Fig. 1 shows such a core section or ring 3; and Fig. 2 shows the built-up core. As shown, the outside edges of the outside core sections 4 and 5 are rounded, this being in order that the windings may closely conform to the surface of the core.

Magnet cores made of silicon-iron alloy, as above described, are cheaper than those made of materials heretofore used because of the readiness with which ferro-silicon in a finely divided form may be produced. The use of the finely divided magnetic silicon-iron alloy, on account of its high specific resistance, reduces the eddy currents and consequent power loss. The softer iron particles, constituting as low as five to ten per cent. of the core and themselves somewhat hardened by compression, do not seriously lessen these advantages, but serve to bind the alloy particles together in a mechanically strong and chemically stable core.

Cores of different mechanical and electromagnetic characteristics may be produced by varying the percentage of iron to alloy, and also by varying the percentage of silicon in the alloy; the latter percentage is preferably above eight per cent. but should not ordinarily rise above thirty per cent.

What is claimed is:

1. A magnet core composed of insulated particles of silicon iron alloy and a binder therefor of insulated particles of relatively soft iron.

2. A magnet core composed of finely divided magnetic material comprising particles of ferro-silicon, and insulating material separating the particles of magnetic material.

3. A magnet core composed of insulated particles of a relatively hard magnetic alloy and insulated particles of relatively soft iron intermixed therewith.

4. A magnet core composed of finely divided ferro-silicon, finely divided relatively soft iron intermixed therewith, and insulating material separating the particles of magnetic material.

5. A magnet core composed of finely divided magnetic material comprising particles of ferro-silicon and insulating material separating the particles of magnetic material, said compound having a specific gravity of approximately 7.

6. A magnet core composed of insulated particles of a relatively hard magnetic alloy and insulated particles of relatively soft iron intermixed therewith, said compound having a specific gravity of approximately 7.

7. A magnet core composed of finely divided ferro-silicon, finely divided relatively soft iron intermixed therewith and insulating material separating the particles of magnetic material, said compound having a specific gravity of approximately 7.

In witness whereof, I hereunto subscribe my name this 27th day of March A. D., 1918.

GUSTAF W. ELMEN.