

## UNITED STATES PATENT OFFICE

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## INDUCTANCE COIL CORE

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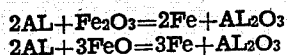
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3 Claims. (Cl. 175—21)

My invention relates in general to an inductance coil core and more specifically to a core for use with loading coils in telephone circuits or other like coils and to the method of making the core.

Among the objects of the invention are to provide an inductance coil core of higher permeability and lower losses than heretofore obtained, which is made from an easily workable material formed at high pressure into cores and which may be heat treated at a temperature near or above the melting point of iron in the presence of hydrogen without damage to the particles forming the core or to the insulating material therein.

My improved core is formed in the following manner. As a core material I use fine iron powder obtained in known manner. The iron powder is first tumbled in moist air and steam at a temperature of approximately 100° C. long enough to provide each particle with a film of iron oxide of controlled thickness. The particles are then tumbled in a rotating vacuum furnace at about 800° C., which may contain a compartment containing aluminum, in such a manner that the vapor from the aluminum passes through the iron dust at an elevated temperature and the iron oxide film over the particles is thus replaced by an adherent aluminum oxide film of uniform controllable thickness in intimate contact with each particle. The reaction takes place according to the equations:



Any other method of introducing aluminum vapor into the furnace will serve. In this process any metal other than aluminum whose oxide is an electrical insulator and which is not reduced by hydrogen may be used. In this manner the iron component of the iron oxide film is reduced in the aluminum oxide film so that the insulating film is itself permeable to some extent, and the thickness of the aluminum film is controlled or determined by the thickness of the iron oxide on the particles.

The iron dust, each particle of which now has an aluminum oxide skin or envelope, is now mixed with a small amount of moistened ceramic refractory material such as alundum or sodium aluminum silicate and pressed into rings or cores by well known methods.

After the core material is formed into cores or rings the rings are heat treated in a tubular furnace at a temperature which may be slightly

higher than the melting point of iron. When the cores are ring shaped the inner tube of the furnace may be of porous alundum which fits into the hole of the rings and the outer tube may be of sillimanite fitting the outer diameter of the rings. A dusting of alundum is used to separate the rings from each other and from the walls of the furnace. Moist hydrogen is passed through the furnace during the heat treatment of the cores. Due to the fact that the aluminum oxide film remains stable in an atmosphere of hydrogen at a temperature above the melting point of iron the particles remain in their normal state and acquire a high degree of permeability under this high heat treatment.

It will thus be seen that this method will produce a magnet core of high permeability and low losses due to the small space required for the insulating film and also due to the high heat treatment possible. The aluminum oxide film is nonconducting and heat resisting and due to the film itself containing reduced iron in a state of molecular subdivision it has some ferro magnetic permeability and thus tends to increase the permeability of the whole core.

Having described the process or method of forming the core what I consider to be new and desire to have protected by United States Letters Patent will be pointed out in the appended claims.

What is claimed is:

1. A method of making inductance coil cores of iron particles which consists in first forming an iron oxide film around each particle, of heating the iron particles in the presence of aluminum vapor to transform the iron oxide film into a film having different characteristics but which contains the reduced iron occluded in the new film being in a nearly molecular state of subdivision, of mixing the insulated particles with a binder, and then forming said particles into cores at high pressure.

2. The method of making inductance coil cores which consists in forming an insulating film around iron particles which film is stable in an atmosphere of hydrogen at a temperature equal to the melting point of iron, of forming the particles into cores at high pressure with a ceramic binder, and subjecting the cores to a heat treatment at the melting temperature of iron in a current of hydrogen containing a trace of water vapor.

3. A method of manufacturing inductance coil cores which consists in oxidizing the surface of iron particles to a predetermined thickness, of roasting the particles in the presence of alumi-

num vapor at about 800° C. to cause aluminum to replace the iron in the oxidized surface and form a film of aluminum oxide  $Al_2O_3$ , containing a portion of reduced iron in a state of molecular subdivision, of mixing the insulated particles with a small amount of ceramic binder and forming

them into cores at high pressure, and then heat treating the cores at the melting point of iron in a current of hydrogen containing a trace of water vapor for a period of hours.

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