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MAGNETIC MATERIALS

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This invention relates to magnetic materials and to a method of preparing the same, and more particularly to a magnetic material having a stabilized permeability over a given temperature range, and to a method of preparing the same.

Magnetic bodies comprising compressed, finely divided magnetic material in the form of dust or assembled thin laminations of magnetic material are extensively used as cores for loading coils, filter coils, transformers, and similar transmission apparatus in telephone circuits. The transmission characteristics of such apparatus are subject to variations due to changes in permeability of the cores with temperature under service conditions. These variations are especially objectionable in the case of high quality, precision circuits.

Objects of this invention are to provide a magnetic material having a stabilized permeability over a given temperature range and a method of preparing the same.

In accordance with the present invention an alloy of molybdenum, nickel and iron is obtained by powdering these materials, compacting the powdered mass and then sintering in a reducing atmosphere at a temperature below the melting point of any of the constituents. The sintered mass is then powdered and added to the material it is desired to stabilize.

Other objects and advantages of the present invention will be more apparent from the following detailed description.

As described in U. S. Patent 2,158,132, issued to V. E. Legg, May 16, 1939, a magnetic core having a substantially constant permeability over a desired temperature range may be prepared by forming the core from a mixture of dust of a normal magnetic material, such as Permalloy, which may comprise approximately 82% nickel, 16% iron, and 2% molybdenum, and which has a positive permeability temperature coefficient over a range of temperature from 55° F. to 95° F., and a proper amount of dust of a magnetic material having a negative permeability temperature coefficient over that temperature range. A magnetic material having such a negative permeability coefficient may comprise approximately 80% nickel, 12% to 13% molybdenum and the rest iron. Such a material, when used for the purpose set forth, acts as a stabilizer of the permeability of the material. However, some difficulty has been experienced in obtaining an accurately proportioned alloy due to loss of some of the molybdenum during melting these ingredients together to form an alloy.

Because a relatively high temperature is required to melt molybdenum, iron and nickel together to form an alloy, and because the melting is usually carried out in an oxidizing atmosphere, some of the molybdenum, which becomes extremely active at increased temperatures, oxidizes, and the oxide so formed volatilizes. Formation and volatilization of this oxide results in a loss of molybdenum. The loss is not constant and, since a variation of 1% in the amount of molybdenum present will cause a corresponding variation of approximately 100° F. in the Curie point of the stabilizer, it will be apparent that even a very slight loss might seriously affect the qualities of the final product.

According to the present invention, the aforementioned metals may be effectively alloyed at temperatures substantially below the melting point of any of them, and without any substantial loss, by powdering the metals, thoroughly mixing the powders together, and then compacting and heating the mixture to a temperature sufficient to sinter. Since oxidation is kept at a minimum, the proportions of each are maintained substantially constant.

In practicing this invention, a stabilizer is prepared by powdering the desired quantities of molybdenum, nickel and iron and then mixing them intimately in a ball mill. A mixture comprising approximately 80% nickel, 12% to 13% molybdenum and the rest iron has been formed to have a negative permeability temperature coefficient over a range of temperature from 55° F. to 95° F. Adequate mixing is ordinarily obtained in approximately 30 minutes. However, it will be apparent that this time will vary with the type of mill and the quantity of material, and is not critical. The mixture is compressed and compacted into a pellet at from 100,000 to 200,000 pounds per square inch pressure and the pellet is then heated at from 1900° F. to 2000° F. for from five to six hours in a reducing atmosphere, such as hydrogen, to cause the particles to sinter.

The sintered pellet is then ground to a fine powder and the powder may then be mixed with the Permalloy dust, the particles of which have been insulated. The mixture so obtained may then be compacted to form a magnet core. Using a Permalloy as hereinbefore described, the particles of which have been insulated, as described in the patent to A. F. Bandur, 2,105,000, issued January 11, 1938, the permeability of a core so formed may be stabilized over a range of 55° F. to 95° F. by the addition of from .2% to 1% of the stabilizing powder, the minimum amount of

stabilizing powder which will accomplish the desired stabilization being used because of the high hysteresis loss of the stabilizer material.

While this invention has been described in connection with the manufacture of a stabilized magnetic material, it will be understood that the method of this invention may be applied in many other instances, particularly where it is desired to maintain exact proportions of certain materials as described, and that while but one embodiment of this invention has been described, many changes and modifications may be made therein without departing from the spirit or scope of the present invention.

What is claimed is:

1. A method of preparing magnetic materials comprising compacting a powdered mixture com-

posed of 12% to 13% molybdenum, 80% nickel and the rest iron, heating the compacted mixture in a reducing atmosphere to sinter, powdering the sintered material, adding the powdered material to insulated Permalloy dust, and compacting the mixture so produced.

2. A method of preparing magnetic materials comprising compacting a powdered mixture composed of 12% to 13% molybdenum, 80% nickel and the rest iron, heating the compacted mixture in a reducing atmosphere to sinter, powdering the sintered material, adding .2% to 1% of the powdered material to insulated Permalloy dust, and compacting the mixture so produced.

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