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FREDERICK J. GIVEN, OF EAST ORANGE, NEW JERSEY, ASSIGNOR TO BELL TELEPHONE LABORATORIES, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK

PROCESS OF MANUFACTURE OF MAGNETIC CORES

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This invention relates to magnetic material and particularly to the manufacture of magnetic dust cores from nickel-iron or other magnetic alloys.

An object of this invention is to provide a method of manufacturing magnetic alloy dust cores having uniform characteristics.

A related object is to minimize waste in the manufacture of cores having such characteristics.

In the manufacture of magnetic dust cores it is desirable that the cores have uniform characteristics such as uniform permeability, stability, eddy current losses and hysteresis losses. It is also desirable to have the last two quantities as low as possible. To obtain the characteristics desired, the percentage of nickel, iron and impurities must be carefully controlled, and in typical cases is held to within 1% or 2% of the prescribed composition. Also, if the annealing and insulating processes are not carried out within the required limits of deviation, the dust may not be within the stability requirements and must be rejected or used for poorer grade cores. The process of this invention increases the number of permalloy dust cores having satisfactory characteristics over the number manufactured with past methods for a certain amount of raw material.

It has been discovered that if a quantity of permalloy dust from ingots having too low a content of one component of a composition is mechanically mixed with a quantity of dust from ingots having a high or a too high content of the same component, the resulting mixture has characteristics intermediate the characteristics of the original quantities. It has also been discovered that if a certain quantity of permalloy dust having a negative stability characteristic is mechanically mixed with a quantity of permalloy dust having a positive stability characteristic, the resulting mixture has a stability characteristic between the characteristics of the original quantities. These results were found to be true where the stability characteristics of the original quantities were both positive and where the characteristics concerned were the permeability and core losses of the material as well as the stability. These findings form the basis of the present invention.

In the previous method of manufacturing permalloy dust cores where the melts comprise nickel, iron and impurities in certain percentages, the composition is controlled as accurately as practicable when charging the furnace. However, it is practically impossible, on a commercial basis, to make the compositions of the resulting ingots from all melts identical, or always within the desired deviations from the prescribed composition. The ingots of each melt are analyzed, however, and the compositions noted. The ingots within the composition requirements are then ground into dust and the dust annealed, insulated and pressed into cores. The annealing of the dust is carried out in lots, each annealed lot being tested for permeability and stability by having a sample core made up and tested. If the core is within the requirements the lot of dust from which the sample core was made proceeds in the manufacturing routine and results in satisfactory cores. While this process results in satisfactory cores, the difficulty of controlling the composition of the alloy within the required limits has resulted, in the past, in the rejection of a large percentage of the core material, which represented a waste since the material must be scrapped or else reworked.

The present invention reduces this waste or the amount of dust formerly rejected as being unsatisfactory for high grade cores. The invention in effect extends the limits within which the composition of the ingots may be held and the limits within which the characteristics of the annealed dust may be held, and still results in more uniform and higher grade average product than was obtained by prior art methods.

In one embodiment of the invention and in accordance with the discoveries outlined above, the dust from ingots having a low content of nickel is mixed with dust from ingots having a high content of nickel so that on reaching the annealing stage the composition is a mechanical mixture having an overall composition which is within the requiremetnts. This permits utilizing ingots

having unsatisfactory compositions and compositions outside former requirements, providing therefrom a dust mixture which will make up into satisfactory cores. The ingots are analyzed and those having compositions which will make up into first grade cores are ground and sent through the routine process as mentioned above. However, those which will not make up into satisfactory cores are held back until ingots having compositions oppositely proportioned are found. These unsatisfactory ingots are then ground and the dust therefrom mechanically mixed and sent through the routine process.

The next step is the annealing process which is accomplished by placing a certain quantity or lot of dust in annealing pots and subjecting the dust to certain temperatures for certain periods of time. As mentioned hereinbefore with respect to holding the composition of the ingots to their optimum composition, it is also difficult on a commercial basis to control the elements affecting the annealing of the dust to always produce a uniform anneal for all lots of dust. Consequently different lots of dust have different anneals and different characteristics. In the course of manufacture, according to prior art practice, each lot of annealed dust is placed in a separate bin for analysis, the analysis consisting of the making up of sample cores from each lot and testing these cores for their permeability, stability and core losses as mentioned above. The lots of dust which show by this test that they will make up into satisfactory cores are then put through the remaining steps of the core manufacture such as insulating and pressing into rings or laminations from which the cores are built up.

In accordance with the present invention, however, the lots of annealed dust which by the old process would have been rejected, are now made into satisfactory cores. The lots which show a permeability or stability which is without the acceptable limits in one direction, are mechanically mixed with the lots which show a permeability or stability varying in the opposite direction from the mean. For instance, if the stability of the sample core from one lot gives a positive characteristic of 5 and another sample core from a different lot gives a negative characteristic of 5, the mixing of the two lots of dust in equal parts will produce a core which will give theoretically a perfect stability characteristic. If a change of ± 2 is allowable then dust producing cores having a stability of zero to $+6$ may be mixed with dust producing cores having a stability of -4 and provide satisfactory cores. No objectionable effects are produced on the core losses when the permeability or stability characteristics are regulated in this way. After the tests, the lots, according to their analyses are mechanically mixed in proportion to their departures from the required analysis and sent through the remaining steps of the manufacturing process as outlined above.

In the employment of the above described process, cores having more uniform characteristics are obtainable from a wider variation in both the composition of the original alloys and in the characteristics of the annealed dust.

What is claimed is:

1. In the art of making magnetic cores of finely divided magnetic alloys, the method of securing a core of given magnetic characteristics from finely divided alloy material which deviates in its characteristics from the characteristics to be obtained, comprising mechanically mixing together proportionate parts of the finely divided core material whose characteristics deviate from the desired values, in relative quantities dependent upon the direction and extent of such deviations to produce a mixture having the required resultant characteristics.

2. A process of manufacturing magnetic dust cores comprising mechanically mixing a definite quantity of dust having one composition and an unsatisfactory characteristic in one direction with a quantity of dust having another composition and an unsatisfactory characteristic in the opposite direction to obtain a satisfactory characteristic for the mixture.

3. A process of manufacturing magnetic dust cores from iron-nickel alloys having a definite composition and value of stability from grades of dust having unsatisfactory compositions and values of stability comprising mechanically mixing a certain quantity of said dust having an unsatisfactory composition and value of stability in one direction with a measured quantity of dust having a proportionate deviation in the opposite direction from said desired definite composition and value of stability.

4. A method of manufacturing magnetic dust cores having a definite composition and characteristics within certain limits comprising first, mechanically mixing a dust composition having too low a content of one component in one direction with a composition having too high a content of said component in the opposite direction, and second, mechanically mixing one mixture of said dust having a poor characteristic in one direction with another mixture of said dust having a deviation from normal in said characteristic in the opposite direction.

5. A process of manufacturing a magnetic dust core having a definite composition and characteristics from nickel-iron alloys having different compositions comprising first grinding said alloys and mechanically mixing the dust from said alloys having too high a nickel content with the dust from said al-

loys having too low a nickel content, and second, annealing said alloys in dust form in definite lots and third mechanically mixing said lots having deviations from normal in characteristics in one direction with said lots having deviations from normal in the same characteristics in the opposite direction.

In witness whereof I hereunto subscribe my name this 30th day of January 1929.

FREDERICK J. GIVEN.