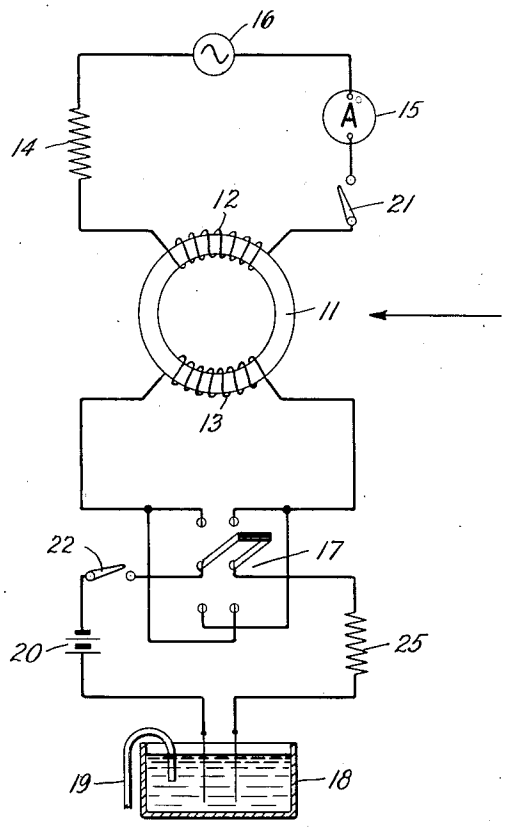
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TREATMENT OF MAGNETIC MATERIALS

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TREATMENT OF MAGNETIC MATERIALS.

Application filed September 1, 1928. Serial No. 303,568.

The present invention relates to treatments of magnetic materials, and particularly to treatments of magnetic compositions containing iron, nickel and cobalt.

Magnetic iron-nickel-cobalt alloys suffer from the disadvantage that when they once have been subjected to the influence of large magnetizing forces, their magnetic properties are detrimentally affected. Two important properties of such alloys, for instance, the permeability and the constancy of permeability with magnetic flux density, are affected, the permeability being increased in most cases as well as the variation of permeability with flux density. Such changes in the properties of the material are injurious, and detrimental to the satisfactory operation of parts wholly or partly made of such material, particularly when used in signaling systems.

It is an object of the present invention to restore the desired magnetic properties to magnetic materials which have been detrimentally affected.

A feature of the invention resides in a method of demagnetizing iron-nickel-cobalt alloys after abnormal magnetization thereof.

In accordance with this invention magnetic compositions particularly iron-nickel-cobalt alloys which have been impaired may have their original properties restored by suitable demagnetizing processes, one example and a few modifications of which will be described herein in connection with the accompanying drawing.

In Fig. 1, a sample having the form of a ring as shown at 11 is surrounded by two windings 12 and 13. Winding 12 is connected through resistance 14, key 21 and measuring instrument 15 to alternating current source 16. Winding 13 is connected through motor driven switch 17, resistance 25, and water rheostat 18 having siphon 19, to direct current source 20. When key 21 is closed, alternating current of relatively high frequency is impressed upon winding 12 surrounding sample 11. Simultaneously, by means of closing key 22 a direct current may be impressed upon winding 13 surrounding sample 11. Motor driven switch 17 has the purpose of periodically reversing the polarity of the direct current supplied by battery 20 and siphon 19 is provided for slowly drawing off the water from rheostat 18 and thus gradually diminishing the flow of current in the direct current circuit to zero. Resistance 25 is provided to practically exclude alternating current from the direct current circuit.

Describing now a few specific examples of treatment, a sample of an alloy containing about 30% Fe, 45% Ni, 25% Co, the permeability of which had been increased by adverse magnetizing conditions from 459 to 664 and for which the variation of permeability up to a flux density of 100 gauss had been increased from .04% to 3.2% was treated as described for about 10 minutes. The alternating current used had a frequency of 4000 cycles/sec and gave a magnetizing force of 1.2 gauss, while the direct current field applied had a value of 10 gauss and was gradually diminished to zero, as described.

As a result of this treatment it was found that the permeability of this sample was reduced to 478, a figure within 4% of the original value, the variation of permeability with flux density being $\frac{1}{5}$ as large as in the magnetized and untreated condition.

In another example a 4000 cycle alternating current having a field strength of 0.38 gauss and simultaneously a direct current field of 10 gauss were superimposed upon a sample having the same composition as the one above mentioned for about 10 minutes. As a result of this treatment the permeability of the material returned from a value of 666 to within 3% of its initial value (459) and the variation of permeability with varying magnetizing forces to a value of $\frac{1}{6}$ of its value in the untreated state.

In accordance with a somewhat modified treatment in which a reversing direct current field alone is used the samples may be heated while being demagnetized, and the intensity of the field gradually reduced to zero, as usual. In one instance a sample having the composition as mentioned above was placed, surrounded by the usual windings, in an ordinary annealing furnace and heated to a temperature of 200° C. In the virgin state this sample had a permeability of 438 and a variation of permeability up to a flux density of 100 gauss of .38%. After having been subjected to adverse magnetization its permeability was 587 and its variation of permeability up to a flux density of 100 gauss was

1.86%. By means of the treatment as described its permeability was brought back to 450 and its variation of permeability up to a flux density of 100 gauss to .55%.

In accordance with another modified treatment a motor driven commutator was employed for the application of a circular direct current magnetic field of about 10 gauss which was periodically reversed about twice per second and the sample ring was placed between the poles of a large electromagnet so that the magnetic flux traversed the ring in the direction shown by the arrow at 11 in Fig. 1. The field of this electromagnet was of the order of about 2500 gauss and it was reversed about once per second by a hand-operated switch and after about 50 minutes both field strengths were gradually reduced to zero by means of rheostats. A sample consisting of a composition containing about 30% iron, 45% nickel and 25% cobalt, which, in the virgin state, had exhibited a permeability of 457 and a variation of permeability of .046% for a flux density of 100 gauss and which after magnetization had a permeability of 514 and a variation of permeability of 1.44% up to a flux density of 100 gauss, after having received this treatment, was measured to have a permeability of 468 and a variation of permeability of only .40%.

The present invention is not limited in its application to the specific compositions of alloy mentioned herein. In particular it is advantageous to treat any or all of magnetic compositions containing between 9% and 81% nickel, between 5% and 80% cobalt and between 9% and 50% iron, with or without fourth elements in amounts up to about 10%, added to increase the resistivity, described in more detail in G. W. Elmen's applications Serial Nos. 119,622 and 119,623, both filed June 30, 1926, and 220,387, filed September 19, 1927, in accordance with the methods of this invention.

What is claimed is:

1. The method of treating magnetic materials which comprises subjecting said materials to the simultaneous influence of a direct current field and an alternating current field, and periodically reversing the direction of said direct current field.

2. The method of treating magnetic iron-nickel-cobalt alloys which comprises maintaining said alloys in a magnetic field composed of a direct current component and an alternating component, and gradually reducing in intensity said direct current component to zero.

3. The method for restoring desired magnetic properties to magnetic materials adversely affected, which includes subjecting said materials to the simultaneous influence of a direct current field and an alternating current field, periodically reversing the direction of said direct current field, and gradually reducing to zero the intensity of said direct current field.

4. The method of improving the magnetic characteristics of magnetic iron-nickel-cobalt alloys which have been adversely affected, which comprises simultaneously super-imposing in said material and an alternating current field of relatively high frequency and a reversing direct current field, and gradually reducing to zero said direct current field.

5. A method of curing detrimental effects in magnetic alloys containing iron, nickel and cobalt, which comprises subjecting said alloys to the simultaneous influence of heat and a reversing magnetic field, and gradually reducing the intensity of said field to zero.

6. The method of demagnetizing a body containing an alloy of iron-nickel-cobalt which comprises applying slow reversals of magneto-motive force thereto and simultaneously producing agitation of the magnetons in the alloy.

In witness whereof, I hereunto subscribe my name this 30th day of August, 1928.

VICTOR E. LEGG.