

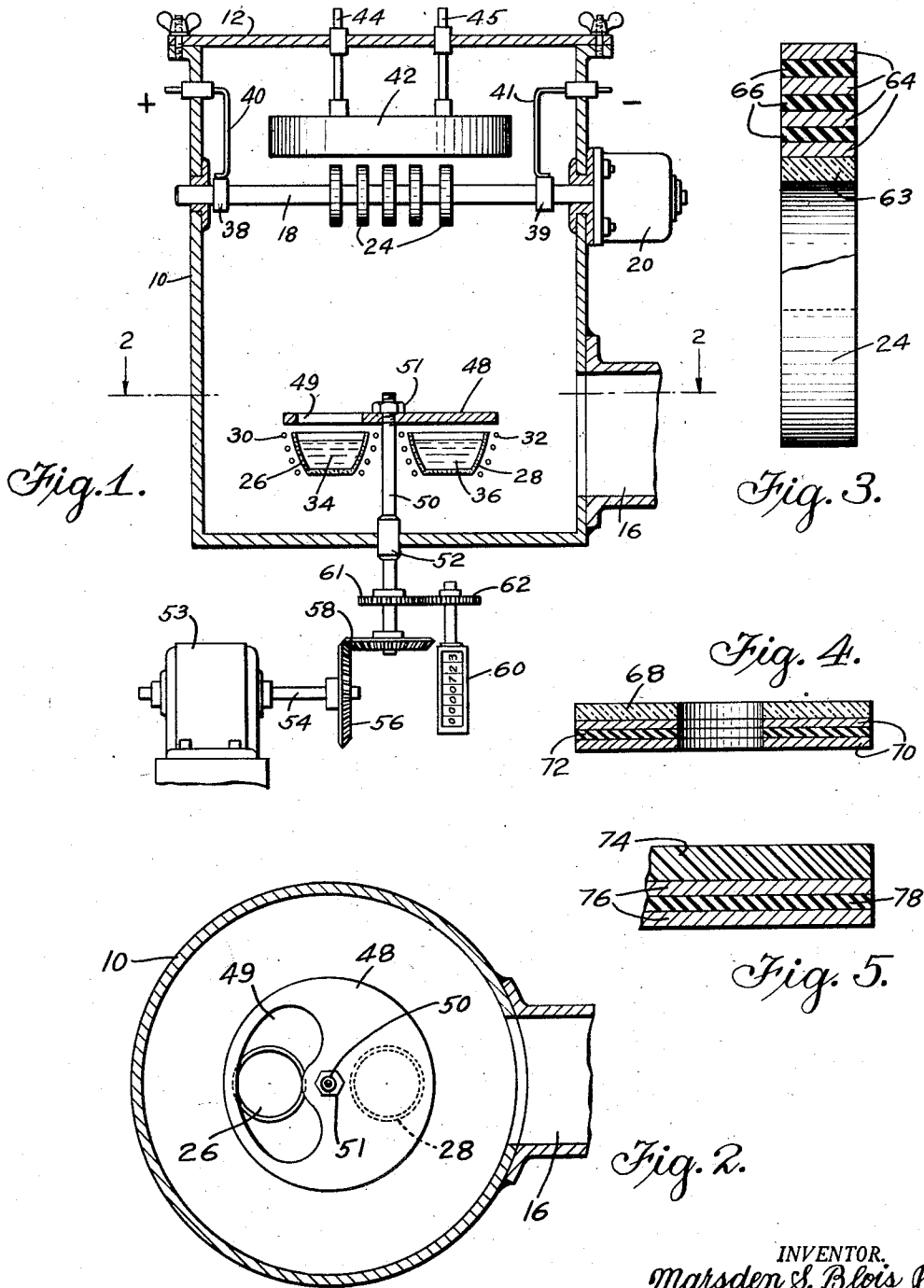
Sept. 23, 1958

M. S. BLOIS, JR

2,853,402

MAGNETIC ELEMENT AND METHOD FOR PRODUCING THE SAME

Filed Aug. 6, 1954



INVENTOR.
Marsden S. Blois Jr.
BY *P. B. Apple*
A. R. McCready
ATTORNEYS.

1

2,853,402

MAGNETIC ELEMENT AND METHOD FOR PRODUCING THE SAME

Marsden S. Blois, Jr., Riverside, Calif.

Application August 6, 1954, Serial No. 448,394

5 Claims. (Cl. 117-71)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

This invention relates to the production of a magnetic element suitable for use in the memory unit of a digital computer, or for other uses where low eddy current and hysteresis losses and high frequency responses are desirable.

Low-loss magnetic elements have been made by the use of thin rolled metal ribbons, but such ribbons cannot be rolled thin enough to obtain the desired low eddy current at high frequencies. In their thinnest forms, they show excessive non-uniformity. The use of magnetic ferrite materials for this purpose has not proven entirely satisfactory, because of low saturation induction, high hysteresis losses, and for some applications, non-rectangularity of the hysteresis loop in the resulting elements.

The present invention contemplates the formation of a magnetic element comprising a base or substrate upon which are deposited, by vacuum evaporation, alternate layers of a magnetic metal or alloy and a dielectric material. By this method of deposition extremely thin layers of a high degree of uniformity may be produced. If the metal film is sufficiently thin (of the order of 500 Angstrom units) it will be single domain with a resulting rectangular hysteresis loop which is desirable for special applications of the type above indicated.

An object of the invention is to produce a low-loss, high frequency magnetic element by an efficient method in the manner above indicated.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following description.

Fig. 1 is a diagrammatic view, partly in vertical section, of an apparatus embodying the invention;

Fig. 2 is a sectional view taken on the line 2-2 of Fig. 1;

Fig. 3 is an enlarged view, partly in section, of an element produced by the mechanism shown in Figs. 1 and 2;

Fig. 4 is a similar view of another form of element; and

Fig. 5 is a similar view of still another form of such element.

The apparatus shown in the drawing comprises a vacuum chamber formed by a shell 10 having a removable cover 12 and maintained under vacuum by means of an exhaust conduit 16 connected to a suitable source of vacuum, not shown. Journaled in the walls of the chamber is a shaft 18 driven by a motor 20 and carrying a plurality of elements 24 of dielectric material such as celluloid or highly glazed ceramic, which forms the base or substrate to be coated as hereinafter described.

At the lower portion of the vacuum chamber are two crucibles 26, 28, heated by any suitable means such as

2

high frequency induction coils 30, 32, and containing respectively ferromagnetic material 34, such as iron or an alloy such as 80% nickel and 20% iron, and dielectric 36 such as silica or magnesium fluoride.

The shaft 18 is electrically insulated from the shell 10 and is fitted with slip rings 38, 39 which contact brushes 40, 41 so that an electric D. C. current may be passed through the shaft during the operation of the device. This current sets up a magnetic field at the surface of the substrate so as to produce an oriented deposit, which has certain useful magnetic properties.

In order that the substrates may be maintained at the proper temperature during deposition, a resistance heater 42 is provided, and is supplied with current through leads 44, 45. A rotary disc or shutter 48 overlies the crucibles and is driven by a vertical shaft 50 rigidly secured thereto by means of a nut 51. The shutter is formed with an aperture 49 which may be of the relative size and shape shown. The shutter thus serves the purpose of alternately uncovering crucibles 26 and 28. The shaft 50 is provided with a vacuum seal 52 and is driven by a motor 53 connected to the shaft by any suitable means such as motor shaft 54 and bevel gears 56, 58. A revolution counter 60 is connected to shaft 50 by means such as gears 61, 62.

In the operation, the metal or alloy containing crucibles may be heated until the contents melt and commence to evaporate. When the desired temperature and vacuum (which may be of the order of 10^{-4} mm. of mercury) have been attained in the vacuum chamber, motors 20 and 53 are started, while current continues to flow through shaft 18, heater 42, and coils 30, 32. With the parts in the positions shown in Figs. 1 and 2, metal vapors pass through the aperture 49, which is momentarily in registry with the crucible 26, to the upper portion of the chamber and form a thin coating of uniform thickness on the peripheries of elements 24. Only the vapor from crucible 26 can reach the substrates 24 when the shutter 48 is in the position shown. The substrate cylinders 24 rotate much faster than shutter 48 so that they will be uniformly coated over their cylindrical surfaces. After a suitable thickness, e. g., 1000 angstrom units, has been built up, the aperture 49 moves out of registry with crucible 26, and thence into registry with crucible 28, where a similar sequence of events causes the deposit of a coating of dielectric upon the metal coating, the procedure being continued until the desired number of alternate coatings, as indicated by the counter 60, have been deposited. It will be understood that the thickness of the coats will be determined by the speed of rotation of shutter 48.

The atoms or molecules undergoing evaporation proceed along straight trajectories (neglecting infrequent scattering from the residual gas molecules in the vacuum), and when they collide with the substrate, remain there for the most part. Since the substrate is revolving at a rate such that it makes a large number of revolutions during the time of deposition, the deposit will be built up uniformly on the outer surface.

The element shown in Figs. 1 and 3, consists of a hollow cylinder 63 of highly glazed ceramic material which is coated on its peripheral surface with alternate layers of ferromagnetic material 64 and dielectric 66. In this and the succeeding figures, the thickness of said layers has been exaggerated and only a few layers are shown, in order to clarify and simplify the drawing.

The element shown in Fig. 4 comprises a hollow disk 68 forming the substrate, upon which are alternate layers of ferromagnetic material 70 and dielectric 72, deposited while the disk is maintained in a horizontal position in the vacuum chamber.

3

The element shown in Fig. 5 is a thin ribbon 74 of organic polymer material or the like coated with layers of ferromagnetic material 76 and dielectric 78 while the ribbon is moved across the path of the evaporated molecules in the vacuum chamber, as by unwinding the ribbon from one spool while taking it up on another.

Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may be practiced otherwise than as specifically described.

What is claimed is:

1. A method of producing a magnetic material, comprising evaporating a ferromagnetic material and causing the vapor to condense upon an insulating film in the presence of a magnetic field to produce a thin magnetic coating.

2. A method of fabricating a magnetic material, comprising evaporating a ferromagnetic material and a dielectric substance and causing the vapors to condense in sequence upon a substrate while in the presence of an applied magnetic field, to produce a laminated deposit with alternating layers of metal and dielectric.

3. A method of forming a low-loss magnetic bistable

4

computer memory unit core comprising depositing from vapor a thin layer of ferromagnetic material on an insulating base in the presence of a magnetic field, depositing from vapor a thin layer of a dielectric material on the first layer, and alternately so depositing additional thin layers of said material and dielectric to form a completed core.

4. Method of producing a magnetic element, comprising evaporating in vacuum a ferromagnetic material and a dielectric and causing the vapors to condense in alternate layers upon a substrate in the presence of a magnetic field and at elevated temperature.

5. A magnetic element formed by the process of claim 16.

References Cited in the file of this patent

UNITED STATES PATENTS

2,414,406	Colbert et al.	Jan. 14, 1947
2,443,756	Williams et al.	June 22, 1948
2,482,329	Dimmick	Sept. 20, 1949
2,501,563	Colbert et al.	Mar. 21, 1950
2,671,034	Steinfeld	Mar. 2, 1954
2,711,901	Von Behren	June 28, 1955
2,740,928	Ward	Apr. 3, 1956

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,853,402

September 23, 1958

Marsden S. Blois, Jr.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 14, claim 5, for the claim reference numeral "16" read
-- 4 --.

Signed and sealed this 20th day of January 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents

UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,853,402

September 23, 1958

Marsden S. Blois, Jr.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 4, line 14, claim 5, for the claim reference numeral "16" read
-- 4 --.

Signed and sealed this 20th day of January 1959.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents