

June 10, 1941.

A. WEIS ET AL

2,245,373

MAGNETIZABLE CORE

Filed Jan. 4, 1938

Fig. 1

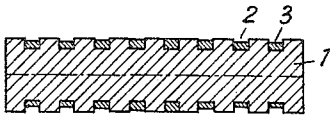


Fig. 2

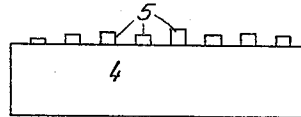


Fig. 3

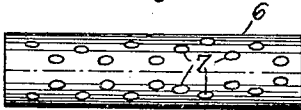


Fig. 3a



Fig. 4

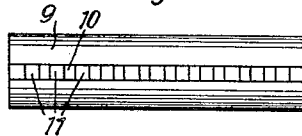


Fig. 4a



Fig. 5

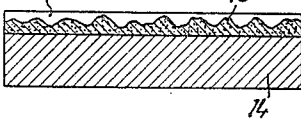


Fig. 5a

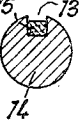


Fig. 4b

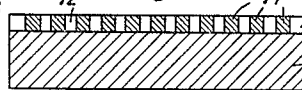


Fig. 6

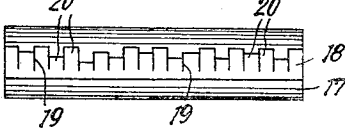


Fig. 7

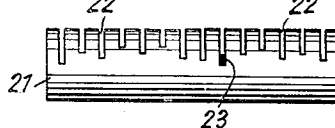


Fig. 8

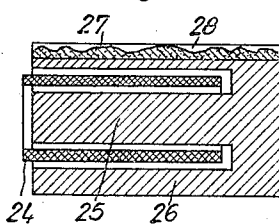


Fig. 9

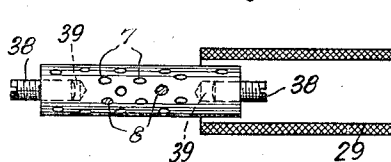
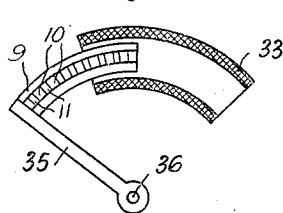


Fig. 10



Inventors
Adolf Weis and
Künther Bremer
by Knight Bros. Attorneys

UNITED STATES PATENT OFFICE

2,245,373

MAGNETIZABLE CORE

Adolf Weis and Günther Drewes, Berlin-Charlottenburg, Germany, assignors to Siemens & Halske Aktiengesellschaft, Siemensstadt, near Berlin, Germany, a corporation of Germany

Application January 4, 1938, Serial No. 183,260
In Germany December 30, 1936

4 Claims. (Cl. 171-242)

The present invention relates to variable self-induction coils whose inductance may be controlled by means of an adjustable magnetizable core consisting of finely divided particles, especially for tuning oscillation circuits. It is not possible to attain with such coils an absolutely accurate ganging of the tuned circuits as to the frequency characteristic when varying several oscillation circuits simultaneously, since the magnetizable cores present irregularities as to their dimensions and structure and thereby cause departures of the inductance values from the required values. It has already been proposed to effect in such oscillation circuits an adjustment by employing variable tuning condensers for the highest frequency in combination with a magnet coil which allows a compensation for the lowest frequency by varying the permeability as well as a compensation for an intermediate frequency by varying the position of the core with respect to the coil windings. Such way of compensation, however, does not ensure a sufficiently accurate ganging of the tuned circuits as to the frequency characteristic for the ranges lying between the three compensated values. By these measures it is not possible to accurately maintain a predetermined frequency characteristic even in the case of a simple oscillation circuit.

The invention has for its object to overcome the above-mentioned difficulties of compensation. To this end the finely divided magnetizable core to be moved into a coil is so designed that the compensation is effected by varying the magnetic property of the portion of the core which is to be inserted in the field of the coil. Such a variation may, for instance, be obtained by varying the cross-sections of the core or by employing different quantities of electrically conducting or magnetic material at different points along the portion of the core to be moved into the coil. This may be accomplished in the manner that the quantity of core material is reduced at certain points. To this end, slots extending transversely to the magnetic axis are arranged in the core. The slots bring about a reduction of the cross-section of the core and therefore a decrease in inductance. A similar effect is attained by placing a greater amount of electrically conducting material in the core, provided that this material is a diamagnetic substance. In this case the decrease in inductance is due to the field displacement within the core by the formation of eddy currents. To increase the inductance it is preferable to apply to the

surface of the core magnetizable material in the form of compressed iron powder.

When compensating, the magnetizable core is inserted stepwise into the coil winding and the inductance is given the corresponding value by adding or removing as the case may be the above-mentioned compensating material. In this manner irregularities in the core material, structure and the like along the magnetic axis are compensated for. The compensating material may have the same permeability as the magnetizable core. A material of different permeability is, however, also applicable. If, for instance, a compensating material of higher permeability than that of the core is used, a very effective compensation may be obtained by means of a small amount of material.

Further details of the invention will be apparent from the following description taken in connection with the accompanying drawing in which

Fig. 1 is a sectional view of a core according to the invention.

Fig. 2 is a longitudinal view showing a modification of the invention.

Fig. 3 shows a similar view of a third embodiment, and Fig. 3a one of a number of magnetic bodies serving to adjust the core of Fig. 3.

Fig. 4 is a longitudinal top view, Fig. 4a a transverse section and Fig. 4b a longitudinal section of a fourth form of the invention.

Fig. 5 shows a longitudinal section and Fig. 5a a transverse section of a fifth magnet core, according to the invention.

Figs. 6 and 7 are longitudinal views of two other embodiments of the invention.

Fig. 8 is a longitudinal section through an arrangement according to the invention in which a core according to Figs. 3a and 3b is provided with a coil.

Fig. 9 shows a sectional view of a coil with a core similar to that of Fig. 3a.

Fig. 10 represents another embodiment consisting of a coil and a core of a construction similar to that of Figs. 4a, 4b and 4c.

In Fig. 1 is shown a bar core 1 which may be moved into a winding and is provided with recesses 2 in the form of grooves, in which compensating bodies 3 may be placed. These compensating bodies are designed in the form of wedges and consist either of a solid metal piece of any suitable material or of the same material as the core 1 which, however, may have a greater permeability in order to attain a great compensation effect with the aid of a small com-

compensating body. The size of the compensating bodies 3 depends upon the change in cross-section of the magnetizable core 1 to be effected at the individual points. Accordingly, the groove-shaped recesses 2 are more or less filled up by the compensating bodies 3 as will be seen from Fig. 1.

In the embodiment of Fig. 2 also showing a magnetic core serving to vary the inductance of a coil, magnetizable or other metal bodies 3 which bring about a compensation of the cross-section are arranged on the magnetizable core 3. The heights of the compensating bodies 3 are different from one another, depending upon the change to be effected in the cross-section.

In the form of the invention according to Figs. 3 and 3a the compensation of the cross-section of the magnetizable core 6 is effected by metallic or magnetizable pins 8 which are placed into the holes 7. In order to effect an accurate compensation it is preferable to thread the holes 7 as well as the pins 8 so that the desired depth of immersion may be exactly regulated by the screwing in of the pins. Also in this case the holes 7 are arranged along the axis of the magnetizable core 6 so that an accurate compensation of the inductance may be attained at every position of the core with respect to a coil winding by varying the cross-section of the core 6.

The greater the number of the recesses and of the compensating bodies provided in the forms of the invention shown in Figs. 1 to 3a the more accurate the inductance characteristic of coils may be adjusted and therefore also the ganging of the coils.

In the modification illustrated by Figs. 4, 4a and 4b the core 9 is provided in the direction of the magnetic axis with a groove-shaped recess 10 in which the magnetizable bodies 11 may be slidably mounted. The bodies 11 may have a dove-tailed cross-section in order to prevent a falling out of the bodies from the groove 10. In this case the compensation is effected by varying the distance of the mutual magnetizable bodies 11. As will be seen from the Figures 4a and 4b the bodies are designed in such a manner that they fill up completely the groove-shaped recess 10 in the vertical direction, whereas their length may be differently dimensioned. Depending upon the width of spaces 12 between adjacent bodies 11 a greater or smaller number of these bodies may be arranged in the groove 10.

The cross-section may be compensated for in the simplest manner by applying a magnetizable substance to the surface of the core. To this end a self-hardening plastic or thermoplastic magnetizable substance may be employed which hardens rapidly and adheres firmly to the core. Such substances have, furthermore, the advantage that when using tools in the form of trowels portions thereof may be again removed or applied to other points so that in this manner the cross-section of the core may be compensated very exactly. Hot tools are preferably employed for thermoplastic substances.

Since in the case of cores which are to be inserted in coil windings, it is preferable not to vary the dimensions of the core, the magnetizable substance employed for compensating the cross-section of the core is arranged preferably in a longitudinal groove 13 of the core 14 as is shown in Figs. 5 and 5a. The magnetizable substance is denoted by the numeral 15 and fills up the groove 13 more or less completely. When using

a thermoplastic material the amount of the magnetizable substance, by means of a hot trowel, may be varied at will at the individual points at which a compensation is to be effected.

According to another form of the invention the compensation of the cross-section of the magnetizable core may be effected by a thin sheet of a variable width or cross-section arranged along the magnetic axis. In this case the sheet consists of magnetizable material, for instance of iron, and is placed on the surface of the core. Such an embodiment is shown in Fig. 6 in which 17 denotes a bar core on which is placed a strip 18 of sheet iron. The strip of sheet iron is slotted transversely with respect to the longitudinal axis as indicated at 19, so that the length of the teeth 20 may be varied by cutting the same so that the effective core cross-section may be adjusted at the individual points at which a compensation is to be effected in order to attain the desired inductance characteristic of a coil.

In Fig. 7 is shown a form of the invention according to which the cross-section of the magnetizable core 21 may be varied by notch-shaped recesses 22. In case too much magnetizable material has been removed when shaping the slots the slots may be refilled as indicated at 23 with self-hardening plastic or thermoplastic magnetizable material as shown in the embodiment according to Figs. 5 and 5a.

With coil arrangements whose slidable core is pot-shaped, the compensation of the core cross-section may be effected for the sake of simplicity on the outer jacket as is shown in Fig. 8, instead of on the core portion projecting into the interior of the coil. 24 denotes the cylinder-shaped coil winding arranged over the inner core portion 25 having also the form of a cylinder, whereas the outer core portion forms a jacket 26 enclosing the coil winding 24. The magnetizable substance 27 for compensating the cross-section of the core is placed as shown in Figs. 5 and 5a in a groove-shaped recess 28 which extends in the direction of the magnetic circuit of the core i. e. in the present embodiment in the longitudinal direction of the outer cylinder-shaped core portion 26.

The use of a core designed in a manner corresponding to Figs. 3 and 3a in a variable self-induction coil is shown in Fig. 9. The inductance of the coil 29 designed, for instance, in the form of a cylinder, is varied by moving the straight core 6 more or less into the coil 29. Over the surface of core 6 are distributed apertures 7 for compensating screws 8 with the aid of which the effective cross-section of the core may be adjusted. The screws 38 arranged at the ends of the core 6 engage in corresponding borings of the core 6 and serve to adjust the initial and final values of the inductance of the coil within a wide range.

In the embodiment according to Fig. 10 is shown a variable self-induction coil 33 which as well as the adjustable magnetizable core 9 has the shape of a circular arc. The core, otherwise, is constructed in the same way as the core shown in Figs. 4, 4a and 4b. The arrangement of Fig. 10 has the advantage that it requires only small space and that the core 3 may be easily adjusted by a rotary movement. To this end, the core 9 is secured to a lever 35 pivoted at an axis 36 which when rotated moves the core 9 into the coil winding 33.

What is claimed is:

1. In a variable inductance device having a coil and a magnetic core movable relative to each other, said core comprising a core body having a magnetic cross section smaller than that required for a desired inductance characteristic of the device, said core body having its peripheral surface recessed along the direction and over substantially the entire extent of said relative movement, and additive magnetic means disposed at said recessed surface and distributed over substantially said entire extent so as to adjust the magnetic cross section locally at different points along said core to said desired characteristic.

2. A magnet core comprising a comminuted core body having its magnetic cross sections smaller than those required for a given characteristic, said core body having a multitude of recesses disposed at its peripheral surface and distributed longitudinally as well as peripherally over a substantial portion of said surface, and a plurality of individual magnetic bodies arranged in said recesses and completing the total cross sections so as to adapt the core to said given characteristic.

3. In a variable inductance device having a

coil and a magnetic core movable relative to each other, said core comprising a core body having a magnetic cross section smaller than that required for a desired inductance characteristic of the device, said core body having at its peripheral surface a groove extending in the direction and over substantially the entire length of said relative movement, and magnetic means for completing said cross section, said means being arranged in said groove and distributed over said length so as to adjust the core to said desired characteristic.

4. In combination with an inductance coil, a magnet core movable relative to said coil and comprising a comminuted core body having its magnetic cross sections smaller than required for a desired characteristic, said body having at its peripheral surface a longitudinal groove, and a plurality of individual solid bodies of magnetic material arranged in and distributed along said groove so as to compensate at a plurality of points the departure of the permeability from said desired characteristic.

ADOLF WEIS.

GÜNTHER DREWES.