Nov. 3, 1964 HISAO MAEDA 3,155,931

WIDE RANGE VARIABLE MAGNETIC INDUCTOR

Filed Jan. 13, 1960

Fig. 1(a)

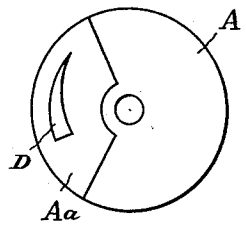


Fig. 2(a)

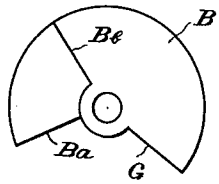


Fig. 1(b)

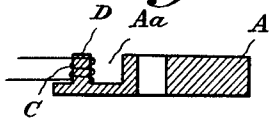


Fig. 2(b)

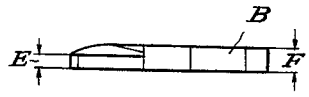


Fig. 3(a)

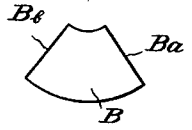


Fig. 4

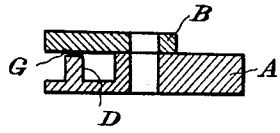
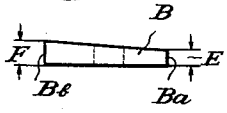


Fig. 3(b)



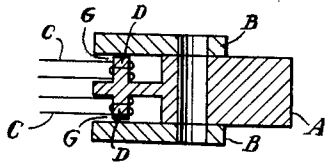


Fig. 5

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WIDE RANGE VARIABLE MAGNETIC INDUCTOR

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This invention relates to variable magnetic inductors for radio frequency use.

It is an object of this invention to provide a variable inductor or inductance coil having a wide range of variation, yet not incurring such disadvantages as to produce howling when incorporated in radio sets.

Said object and other objects of this invention have been attained by the variable inductor of this invention, comprising: a rotating plate and a stationary plate, both said plates being in mutually parallel disposition, each plate being made entirely or principally of a high-frequency ferro-magnetic material; and a coil wound around a protruding core formed on either of said plates, perpendicular to the plane of rotation thereof. The entire assembly of the parts is so constructed that the inductance of said coil varies as a function of the effective permeability of the magnetic path of said coil, said effective permeabilty being made to vary by rotation of the rotating plate relative to the stationary plate, in the contact surface areas and spacing, or gap, between said opposing surfaces, which form the coils magnetic path through the rotating plate and stationary plate.

The details of the invention will be more clearly apparent by reference to the following detailed description of a representative embodiment of the invention when taken in connection with the accompanying drawing, in which the same members are designated by the same references, and in which:

FIG. 1(*a*) is a plan view of the stationary plate of one embodiment of this invention;

FIG. 1(*b*) is a side elevational view of the plate of FIG. 1(*a*), vertically in section;

FIG. 2(*a*) is a plan view of the rotating plate to be assembled with the stationary plate of FIG. 1;

FIG. 2(*b*) is a side elevational view of the plate of FIG. 2(*a*);

FIG. 3(*a*) is a plan view showing a portion of the rotating plate of FIGS. 2(*a*) and 2(*b*);

FIG. 3(*b*) is a side elevational view of the portion of FIG. 3(*a*);

FIG. 4 is a side elevational view, vertically in section, showing the assembled state of the rotating and stationary plates illustrated in FIGS. 1(*a*), 1(*b*), 2(*a*), and 2(*b*).

FIG. 5 is a side elevational view, vertically in section, of an embodiment of the invention similar to that shown in FIG. 4 but having two rotating plates, one above, and one below, the stationary plate.

Referring to FIGS. 1(*a*) and 1(*b*), a stationary plate A made of a high frequency ferro-magnetic material of a certain thickness has a cut-out portion A*a* occupying approximately a semicircle or a fraction of a circle, as viewed in plan view, and a protruding part D disposed in the central part of said cut-out portion, a coil C being wound around said protruding part D.

Referring to FIGS. 2(*a*) and 2(*b*), a rotating plate B made of a high frequency ferromagnetic material is used in assembled state with the stationary plate A. The plate B is approximately a semicircle or it may be larger as viewed in plan view. Furthermore, the plate B has an inclined surface, of a varying thickness, between its parts B*a* and B*b* as clearly indicated in FIGS. 3(*a*) and 3(*b*), so that the spacing or gap G, between the rotating plate B and the protruding part D of the stationary plate A may be varied at the position just above the protruding part D by the rotation of the said rotating plate B, said thickness being made to decrease gradually from F to E.

When said plates A and B are assembled together, their states are as shown in FIG. 4. By the rotation of the rotating plate B, the gap G between the protruding part D of the stationary plate A and the rotating plate B is made to vary. At the same time the confronting area between the part D and plate B is varied. Accordingly, the combination of the above two variations affords an increase in the variable range.

In the present invention, it is possible to adjust the rate of variation of the inductance of the coil C with respect to the angle of rotation by suitably devising the profile configuration in plan view section of the protruding part D and the variation of the thickness of the rotating plate B.

As an alternative construction having the equivalent effect, the rotating plate B imay be made to possess a constant thickness, and the height of the protruding part D of the stationary plate A may be made to vary with a suitable slope.

As another modification, by providing protruding parts on both faces of the plate A, winding coils on both said protruding parts and providing rotating plates such as that of FIG. 2(*a*) on both sides of the plate A to be rotatable thereon, a double variable inductor can be obtained.

FIG. 5 shows this embodiment wherein plate A is provided with a protruding part D both on its top and on its bottom, each of these carrying a coil C, and a rotating plate B, each disposed above and below plate A. There is a gap G between both parts D and both plates B, and the configuration of plates B conforms to that shown in FIGS. 3*a* and 3*b*.

In the present invention, by making the magnetic permeability of the rotating plate higher than that of the stationary plate, the variable range of the inductance can be increased.

In the fabrication and installation of the coil of the invention, it is more convenient to first fabricate a winding spool of such material as styrene, and then to fit said spool on the protruding part D after winding of the coil around said spool. In the fabrication of the aforementioned slope in the thickness of the rotating plate, a rotating plate having a uniform, inclined surface may be obtained by using an iron jig having an inclined surface, placing a disk on said jig, fixing the whole by means of a magnetic chuck, and carrying out grinding and lapping operations.

Various constructions known to prior art of the rotating mechanism are possible for application with the present invention, but need not be described herein.

While I have described particular embodiments of my invention, it will, of course be understood that I do not wish my invention to be limited thereto, since many further modifications may be made and I, therefore, contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

What I claim is:

1. A variable ferromagnetic inductor comprising, in combination, a circular stationary plate made of a high-frequency ferromagnetic material; a rotating plate made of a high-frequency ferromagnetic material and affixed rotatably and parallel to said stationary plate, said rotating plate having a portion with an inclined surface of varying thickness thus providing for varying spacing and contact surface areas relative to said stationary plate; a protruding part formed on either of said plates, perpendicular to the plane of rotation thereof; and a coil

wound around said protruding part; the dimensions and configurations of said plates and said protruding part being devised so that the inductance of said coil is made to vary as a function of the effective permeability of the magnetic path of said coil, said effective permeability being made to vary by the rotation of the rotating plate relative to said stationary plate, in the contact surface areas and spacing between the opposing surfaces, which form the coil's magnetic path through the rotating plate and the stationary plate.

2. A variable ferromagnetic inductor comprising, in combination, a circular stationary plate made of a high-frequency ferromagnetic material and having a recessed portion less than half a circle; a protruding part formed and disposed in said recessed portion; a coil wound around said protruding part; a rotating plate made of a high-frequency ferromagnetic material and affixed rotatably and parallel to said stationary plate, said rotating plate being of a circular shape except that a portion less than a semi-circle has been cut away therefrom, the part which is more than half a circle having an inclined surface of varying thickness thus providing for varying spacing and contact surface areas between the protruding part of said stationary plate and said rotating plate; said protruding part being disposed perpendicularly to the plane of rotation of said rotating plate; the dimensions and configurations of said plates and of said protruding part being devised so that the inductance of said coil is made to vary by the rotation of the rotating plate relative to said stationary plate, in the contact surface areas and spacing between their opposing surface areas, which form the coil's magnetic path through the rotating plate and the stationary plate.

3. A variable ferromagnetic inductor comprising, in combination, a circular stationary plate made of a high-frequency ferromagnetic material; one rotating plate above and one below said stationary plate, made of high-frequency ferromagnetic material and affixed to said stationary plate rotatably and parallel thereto; a protruding part formed on both sides of said stationary plate perpendicular to the plane of rotation of said rotating plates; a coil wound around each said protruding part; said rotating plates having portions of varying thicknesses thus providing varying spacing and contact surface areas relative to said stationary plate; the dimensions and configurations of said plates and of said protruding parts being devised so that the inductance of said coils is made to vary as a function of the effective permeability of the magnetic path of said coils, said effective permeability being made to vary by the rotation of the rotating plates relative to the stationary plate, in the contact surface areas and spacing between their opposing surfaces, which form the coils' magnetic paths through the rotating plates and the stationary plate.

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