

[54] **HIGH FREQUENCY COIL HAVING AN
ADJUSTABLE FERRITE POT CORE**
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336/232
[51] **Int. Cl.**..... **H01F 21/06**
[58] **Field of Search** **336/83, 134, 200, 232,**
336/135

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[57] **ABSTRACT**
A high frequency coil having an adjustable ferrite pot core wherein a movable cylindrical core can be shifted in its axial direction through a center bore in a first pot core member in such a way that one of the frontal surfaces of the movable core together with a fixed member of the pot core forms a variable air gap and wherein the coil is arranged about the fixed member of the pot core and is embodied as a planar winding.

5 Claims, 3 Drawing Figures

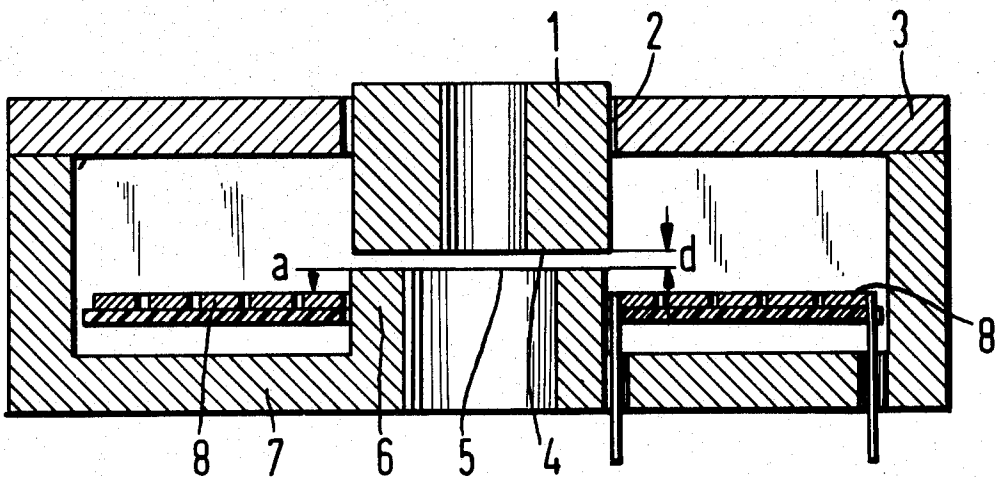


Fig.1

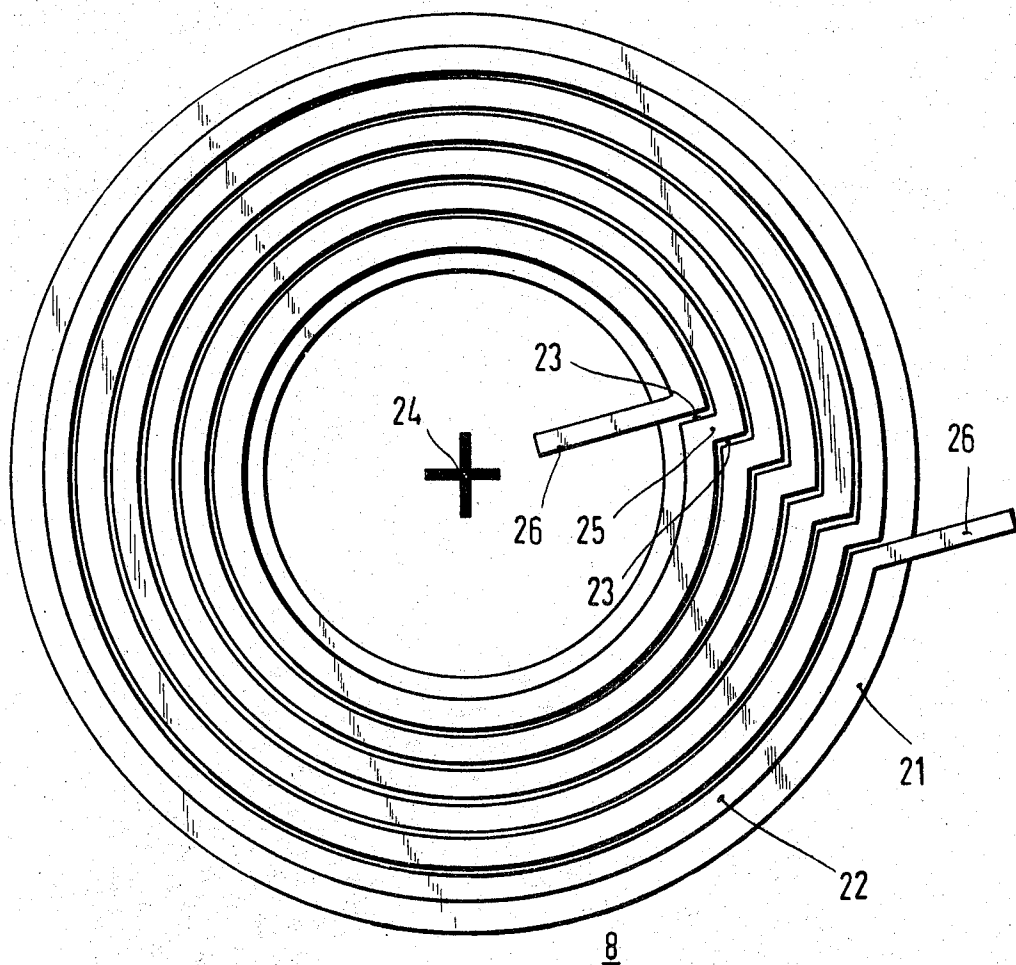


Fig.2

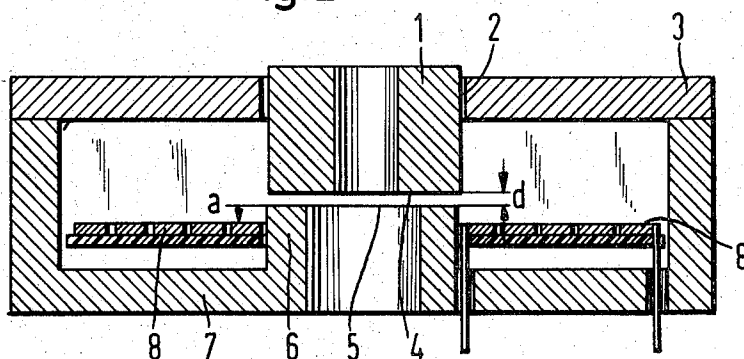
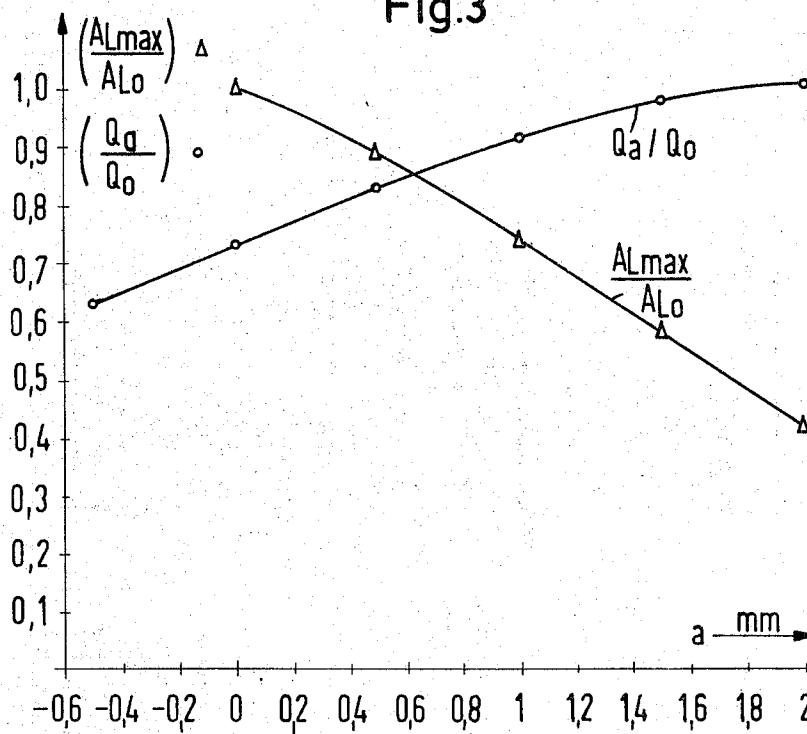


Fig.3



HIGH FREQUENCY COIL HAVING AN ADJUSTABLE FERRITE POT CORE

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a high frequency coil having an adjustable ferrite pot core, and more particularly to such an arrangement wherein a movable cylindrical core is disposed in and can be shifted through a center bore within a first pot core member in the axial direction so that one of the frontal surfaces of the movable core forms a variable air gap between such surface and a fixed member of the pot core.

2. Description of the Prior Art

Pot cores are known, for example, from the German Letters Patent 1,276,234. A particular type of pot core is called a rectangular module core, or simply an RM core. Of particular concern, therefore, is a ferrite core whose core parts are provided with recesses in such a way that a rectangular or squared profile is produced for the entire arrangement when the coil member is inserted.

Among other requirements, it is necessary in the design of filter coils comprising adjustable ferrite pot cores to realize each desired inductance value at as great a coil quality as possible within a given inductance spectrum. For this purpose, the inductance values are relatively small, for example 30 nH through 1,000 nH as high frequencies in the order of, for example, 10 MHz through 100 MHz. Since the number of windings for the coil is low, for example only one through six windings may be required, the changes in inductance per winding are correspondingly great.

SUMMARY OF THE INVENTION

The present invention is based on the task of providing a pot core which can be adjusted with respect to its A_L value or its inductance or a core of a similar shape, for example an RM core having a high frequency coil of the initially mentioned kind, comprising as great a variation range as possible whereby a high coil quality is obtained along with a space saving construction at a particular height of structure. The A_L value mentioned above refers to the quotient of the inductance and the square of the number of turns of the coil, therefore

$$A_L = L/N^2.$$

According to this invention, the foregoing task is achieved in such a way that the coil is arranged around the fixed part of the pot core and is embodied as a planar winding.

Due to the above measures, a coil of little structural height is obtained and such coil has a relatively great adjustment range, whereby high coil quality is simultaneously guaranteed.

According to a further development of the invention, it is provided that the number of windings of the coil respectively consist of a circular ring of a conductive layer interrupted by a narrow separation slot, that adjacent windings are connected with each other by means of sections of the conductive layer which extend approximately in the radial direction, and that the radially extending sections are arranged between the separating slots of the respectively adjacent windings and are partially separated with respect to such slots.

With the coil composed of arc-shaped conductive paths, a great conductor cross section and therefore a great coil quality can be realized within a given basic outline. It should be pointed out that one more winding can be placed with an equal outer diameter of the winding and with an equal width of the conductor paths, as compared with a spiral shaped winding, for example in the form of an Archimedean spiral.

Furthermore, a plane may be selected as the winding configuration for a coil, according to the present invention, which plane extends parallel to the frontal surface of a fixed part of the pot core and at a small distance from such surface.

Due to the aforementioned measure, it is provided that the coil is positioned essentially beyond the range wherein magnetic force lines extend from the air gap between the fixed and movable parts of the pot core. Therefore, an advantage results in that essentially no losses are produced in the coil due to stray magnetic flux emerging at the air gap, in the conductors of the coil, when the movable core is shifted away from the fixed part of the pot core. For this reason, the quality of the coil decreases to only a minor extent due to the effect of the stray flux caused by an increase in the length of the air gap.

In a preferred embodiment of the invention the distance of the plane of the coil from the frontal surface of the fixed part of the pot core amounts to 1/2 through 1/6 of the variable air gap.

With an adjustment range of the air gap from, for example, 1-3 millimeters, approximately 0.5 millimeters is selected for the distance from the plane of the coil to the frontal surface of the fixed part of the pot core. Due to this dimensioning of the distance of the coil from the frontal surface of the pot core, a high core quality is obtained along with as great an adjustment range as possible for the inductance of the device.

In a further development of the invention it is provided that the coil is arranged in the form of a so-called printed circuit upon a printed wiring board or an insulator material foil, that the coil is constructed in accordance with a thick layer or thin layer technique and arranged upon a substrate member, that the coil is punched out of a metal sheet and fixed upon an insulator material, or that the coil is etched from a metal sheet.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features and advantages of the invention, its organization, construction and operation will be best understood from the following detailed description of a preferred embodiment thereof taken in conjunction with the accompanying drawings, on which:

FIG. 1 is a plan view of a planar coil constructed of arc-shaped conductor paths;

FIG. 2 is an elevational view, shown in section, of a high frequency coil having an adjustable ferrite pot core; and

FIG. 3 is a graphic illustration of a plot of coil quality and adjustment range of the coil shown in FIG. 2 as a function of the distance of the coil from the frontal surface of the fixed part of the pot core.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to FIG. 1, a planar coil 8 is illustrated in detail as comprising a fixed winding of a band-shaped

conductive layer. The bandshaped layer is arranged as a printed circuit upon an insulator material plate 21. Each turn or winding 22 of the coil 8 is embodied as a circular ring. The circular rings are respectively interrupted by narrow separations 23 and are arranged concentrically about the coil center point 24. Adjacent ones of the windings 22 of the coil 8 are respectively connected by a section 25 of the conductive layer which generally extends in the radial direction.

The width of the radially extending sections essentially coincide with the width of the conductive layer of each winding. The radially extending sections 25 are arranged between the separation slots 23 of the respectively adjacent windings in such a way that they too are partially separated thereby.

In order to obtain an economical production of the coil 8, terminals 26 made of a copper sheet are chemically etched simultaneously with the coil, and such terminals may be provided at an angle with respect to the plane of the coil in accordance with particular terminal connection requirements. It is furthermore advantageous to electrodeposit silver over the entire surface of the coil.

The high frequency coil structure illustrated in FIG. 2 comprises an adjustable ferrite pot core wherein a movable cylindrical core 1 can be shifted in the axial direction through a center bore 2 in a first core part 3 in such a way that one of the frontal surfaces 4 of the movable core forms a variable air gap d with the frontal surface 5 of a fixed part 6 of a pot core 7. Of course, a pot core or a bell-shaped core may be employed as the core part 3. The coil 8 (see FIG. 1) is embodied as a planar coil and is arranged about the fixed part 6 in such a way that the winding plane extends parallel to the frontal surface 5 of the fixed part 6 and at a distance a from the surface 5. In addition to the small construction height for the device, this arrangement of the coil 8 results in the advantage that no current loss of any consequence is produced in the coil which would lower the coil quality $Q = \omega L/R$ when the movable core 1 is removed, due to the stray magnetic flux i emerging at the shearing air gap d .

Referring to FIG. 3, the quality curves $Q_a/Q_o = f(a)$ have been illustrated for an air gap d of 1-3 millimeters. As can be seen from FIG. 3, the frontal surface 5 of the fixed part must be 2 millimeters above the plane of the coil 8 in order to avoid a decrease of the coil quality Q_a with an effective air gap d of 2 millimeters. With this position of the plane of the coil 8, however, the inductance value which can be obtained with a fully inserted part 1 ($d = 0$) and therefore the maximum adjustment range which can be obtained would lower according to the curve A_{Lmax}/A_{Lo} to 40 percent of the maximum adjustment range. The maximum adjustment range can be obtained at a distance $a = 0$ of the plane of the coil 8 from the frontal surface 5 of the fixed part 6. At a dis-

tance $a = 0$, the plane of the coil 8, or the upper edge of the coil 8, respectively, will be in the plane of the frontal surface 5 of the fixed part 6. In this case, however, the quality of the coil is only 73 percent of the quality Q_o which is provided at a distance $a = 2$ millimeters of the plane of the coil 8 from the frontal surface 5 of the fixed part 6. In order to obtain as great a coil quality Q as possible, while simultaneously obtaining as great an adjustment range A_{Lmax}/A_{Lo} it is therefore required that one select an optimum distance where $d \approx 0.5$ millimeters. With an adjustment range of the air gap d from 1-3 millimeters, $1/2-1/6$ of the adjustment of the air gap d will result for the distance d of the plane of the coil from the frontal surface of the fixed part 6.

Although I have described my invention by reference to a specific illustrative embodiment thereof, many changes and modifications of the invention may become apparent to those skilled in the art without departing from the spirit and scope of the invention. I therefore intend to include within the patent warranted hereon all such changes and modifications as may reasonably and properly be included within the scope of my contribution to the art.

I claim:

1. High frequency coil apparatus, comprising: a variable air gap pot core including a first core member having a bore therein, a second core member having a fixed part with a surface facing said bore, and a movable core member disposed in and movable in said bore and having a surface which with the surface of said fixed part defines a variable air gap; and a planar coil disposed about said fixed part which comprises a plurality of concentric circular conductors each having a separation therein, and a plurality of radially extending conductor sections, connecting adjacent circular conductors at respective separations and wherein the plane of said coil is parallel to said surface of said fixed part and is disposed at a distance from said surface of said fixed part in the range of from $1/6$ of the maximum length to one-half of the minimum length of the variable air gap.

2. Apparatus according to claim 1, wherein said planar coil comprises a foil of electrically insulating material and printed circuit windings carried on said foil.

3. Apparatus according to claim 1, wherein said planar coil comprises an electrically insulating substrate and a conductive layer deposited on said substrate.

4. Apparatus according to claim 1, wherein said planar coil comprises an electrically insulating substrate and a metal strip fixed upon said substrate.

5. Apparatus according to claim 1, wherein said planar coil comprises terminals extending at an angle with respect to the plane of said coil.

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