June 24, 1952 C. L. SNYDER 2,601,338

VARIABLE PARALLEL RESONANT CIRCUIT

Filed Oct. 31, 1947 2 SHEETS—SHEET 1

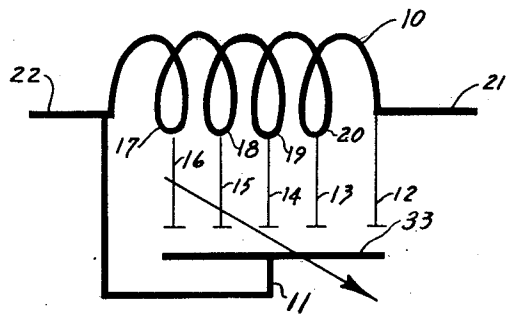


FIG. 1

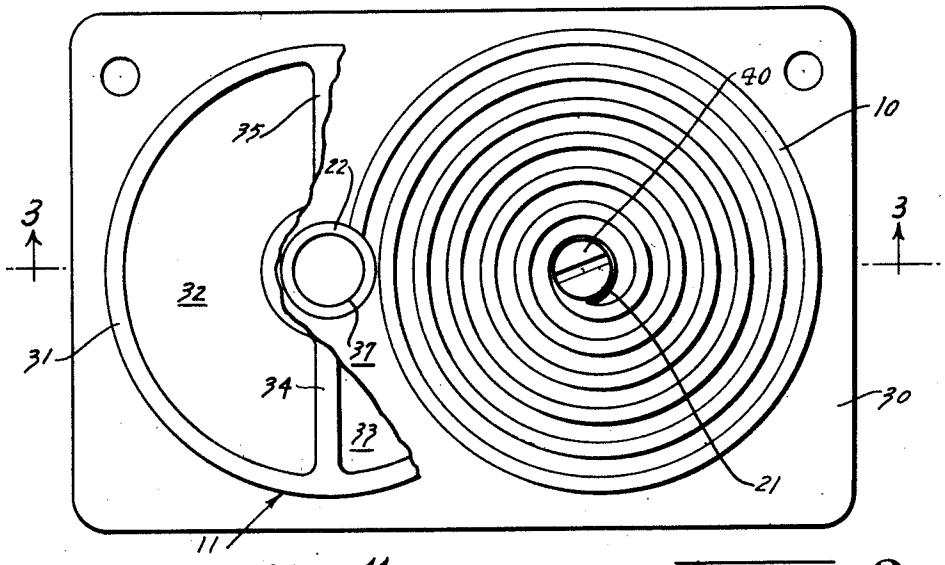


FIG. 2

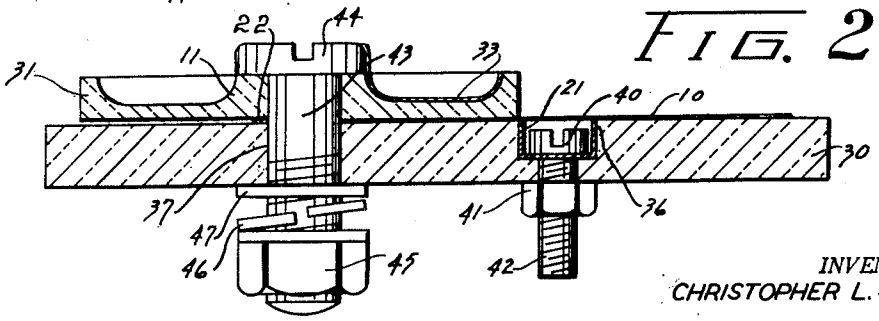


FIG. 3

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VARIABLE PARALLEL RESONANT CIRCUIT

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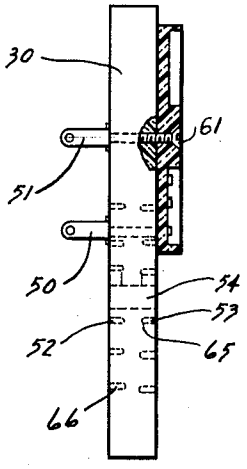


FIG. 5

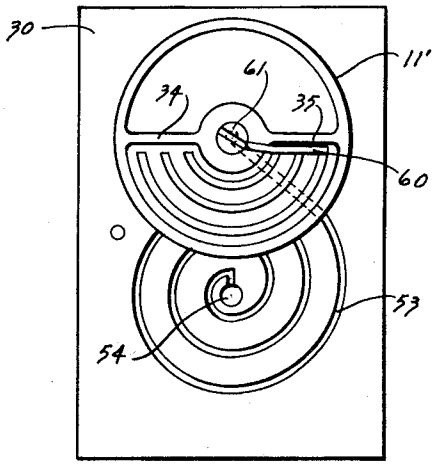


FIG. 4

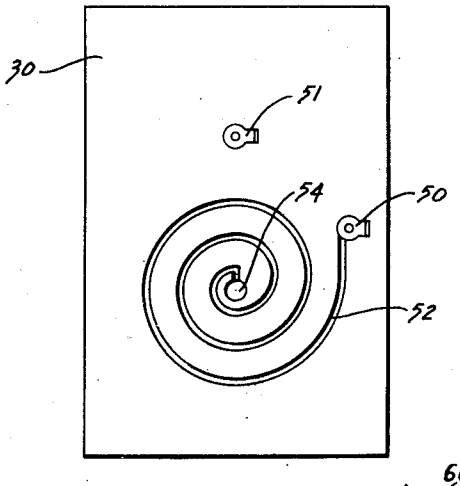


FIG. 6

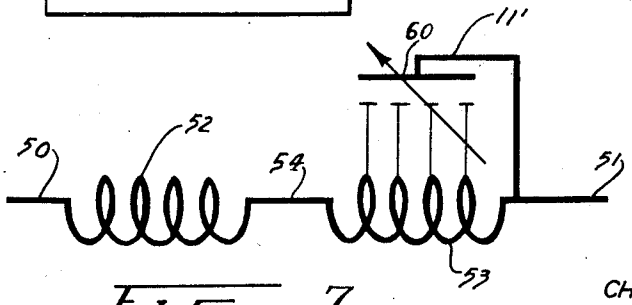


FIG. 7

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VARIABLE PARALLEL RESONANT CIRCUIT

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Application October 31, 1947, Serial No. 783,238

5 Claims. (Cl. 250—40)

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This invention relates to a variable parallel resonant circuit. More particularly it relates to a high frequency tuning circuit.

An object of this invention is to devise a simply constructed high frequency variable tuning circuit having a high stability.

Another object of the invention is to provide a high frequency tuning circuit which does not require a crystal for control and which has a stability comparable with that of a crystal controlled circuit.

These objects and others ancillary thereto are obtained by printing or otherwise impressing upon the surface of a steatite or other insulating base material, a spiral of silver or other conducting metal, and by providing a rotating disc or segment thereof adapted to rotate about an axis adjacent the spiral so that a portion of the disc over-laps the spiral. The rotating disc is also made of insulating material such as steatite, plastic, mica or titanium dioxide compositions and the said rotating disc has a silver deposit on a surface which is spaced from the spiral on the first named steatite surface. Preferably the ends of the spiral terminate in holes and the hole at the outer end is the axis about which the disc rotates. The terminals are located at the ends of the spiral, i. e., at the said holes.

The silver is printed on the steatite surface or on the disc in any suitable way. For example, a silver paint containing a finely divided metallic silver, an oil vehicle and a glaze may be applied to the steatite surface by spraying, brushing or by a silk screen printing process and the silver paint may then be fired on the surface. The paint or silver may be applied in the form of a spiral to the flat surface or the steatite surface may be made to contain a spiral groove in its manufacture and the silver metal paint may then be applied to the top of this grooved surface or into the depressions of the grooved surface as desired.

The metal coating should be at least 1 or 2 mils in thickness because if the coating is too thin the resistance is too high. The spiral form may be round or angular. For some purposes it is easier to make a square to rectangular spiral. The width of the metal coating should be equal to or less than the space between adjacent coils of the spiral. If desired the coating may pass around the steatite body in coil form.

Silver is a preferred metal, but any conducting metal may be employed such as gold, copper, aluminum, etc.

The base of the device is preferably steatite, but it may be any of the well-known insulating

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materials such as, for example, mica, glass bonded mica, or synthetic resinous material such as phenol formaldehyde resins, tetrafluoro ethylene resins, polystyrene resins, etc.

The construction of the disc is important as it is the material of the disc which forms the dielectric of the condenser. Preferably the disc is made from a mixture of titanium dioxide and magnesium titanate. The magnesium titanate has a dielectric constant of about 15 and the titanium dioxide has a dielectric constant of about 90 so that the dielectric constant of the disc may be made to vary between 15 and 90. Obviously it would be preferred to have the dielectric constant high if this were the only consideration. However, it has been noted that the temperature coefficient of capacitance of titanium dioxide is -750×10^{-6} per °C., and that the temperature coefficient of capacitance of magnesium titanate is 120×10^{-6} per °C. It will be seen that by properly combining titanium with magnesium titanate a composition can be obtained which has a zero temperature coefficient of capacitance. Even this, however, is not all that is to be taken into consideration since the induction spiral has a positive temperature coefficient of capacitance. The disc is therefore made with a composition which has a negative coefficient of capacitance of sufficient amount to just compensate for the positive coefficient of capacitance (with temperature) of the inductance spiral. It will be seen, therefore, that the device of the present invention can be made to have great temperature stability, or any temperature characteristic desired within the limits of the materials available.

The coating on the disc preferably covers only a portion of the disc—for example, half of the disc—and this coating may be a solid coating in the shape of a half moon or it may follow some some exponential curve in order to relate the angular displacement of the high dielectric constant disc with a predetermined tuning curve. The coating may also be of the Faraday shield type so that eddy currents are reduced. The disc is shown as round in Figs. 2 and 4, but it is obvious that it may take any suitable shape. The rotatable member may be only a segment of a disc.

The novel features characteristic of this invention are set forth with particularity in the append claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood when the following description of specific embodiments when

read in connection with the accompanying drawings in which:

Figure 1 is a schematic diagram of one type of device made according to the present invention.

Figure 2 is a plan view partly broken away of a device constructed according to the invention.

Figure 3 is a cross sectional view taken on line 3—3 of Figure 2.

Figure 4 is a top plan view of a modified form of the device.

Figure 5 is a side view of the device of Figure 4.

Figure 6 is a rear view of the device of Figures 4 and 5.

Figure 7 is a schematic diagram illustrating the circuit elements obtained by the device of Figures 4–6.

In Figures 1–3 of the drawing, the terminals are shown at 21 and 22. The inductance 10 is shown as a coil in Figure 1 and is shown as a spiral in Figure 2. The condenser is shown diagrammatically at 11 in Figure 1 and in the form of a disc at 11 in Figure 2. The electrode 33 of Figure 1 corresponds to the electrode coating 33 in Figure 2. In the operation of the device the condenser portion of the device acts as a plurality of operating condensers as illustrated at 12, 13, 14, 15 and 16 of Figure 1, one portion of each of these condenser functions being opposite one of the coils of the inductor.

In the actual construction of the device, a steatite block 30 is first formed and a silver spiral 10 is fired onto the steatite block 30. The steatite block 30 contains two holes 36 and 37 at which points the spiral 10 terminates. The center of the spiral 21 terminating in the orifice 36 may contain a screw-threaded bolt 42 having, for example, a head 40 and a nut 41 and this bolt 42 may be connected to any desired electrical apparatus. The second terminal 22 of the spiral 10 contains the hole 37, which forms the axis about which the disc 11 rotates. The disc 11 is formed with a rim 31 and is divided into two halves by ribs 34 and 35. Into one half of the depression in the disc there is deposited a coating of silver 33. In the other half 32 of the disc 11 there is no deposit. The disc 11 is connected to the steatite base 30 by means of the screw-threaded bolt 43 having an enlarged head 44 and a nut 45. Between the nut and the block or base 30 there is a spring 46 and a washer 47 to resiliently hold the disc 11 in place.

In operation the device is attached to an appropriate circuit and the circuit is tuned by rotating the disc 11 so that a varying area of the adjustable electrode 33 of the capacitor 10, 33 formed by the silver coating 33 on the face of the rotatable disc 11 is positioned over the fixed electrode 16 of said capacitor represented by the spiral silver coating 10. By rotating the disc 11 about its vertical axis the resonant frequency of a circuit connected to the bolts 42 and 43 as terminals of the condenser and coil may be adjusted.

In the device of Figures 4–7 a circuit containing two conducting coils with mutual inductance aiding and a variable condenser is shown. In this modification each side of the steatite base 30 contains a spiral of conducting material. The front of the device which contains the condenser 11' also contains a spiral 53 whereas the back of the device contains a spiral 52. The terminals are shown at 59 and 51 on the back of the device. (See Figures 5 and 6.) In the device shown in this modification the metal spirals are contained in grooves 65 and 66 respectively which have been impressed into the steatite material before firing. These spirals are connected together by metal coating which extends through the orifice 54. The spacing between the coils may be varied to vary the mutual inductance of the coils and the inductances of the two coils may be formed to oppose or reinforce one another. A different type of metal coating on the condenser disc is shown in Figure 4. As shown in this figure the metal coating 60 is the Faraday shield type of condenser element and is constructed so as to reduce eddy currents. In the modification shown in Figures 4–6 the disc 11' is rotatably attached to the steatite member 30 by means of the screw 61. The end of the screw 61 may also hold the terminal 51.

The way in which the device of Figures 4–6 operates is illustrated by the schematic drawing of Figure 7. For example, the electrical impulses first pass through the inductance 52 and then through the inductance 53 which is spaced with reference to the inductance 52 so as to obtain the desired mutual inductance. The resonant frequency of the circuit is then changed by adjusting the variable condenser 11' in a way which is obvious to one skilled in the art.

It will be seen, therefore, that this invention provides a very stable high frequency parallel resonant circuit.

This invention, therefore, is not to be restricted except insofar as is necessitated by the prior art and by the spirit of the appended claims.

I claim:

1. A condenser-inductance unit for providing a variable parallel resonant circuit comprising an insulating base, an extended linear layer of conducting material on a top surface of said base, said extended linear layer being curved upon itself a number of times so as to provide at least two concentric, non-intersecting linear portions adjacent each other to form an inductive impedance, a disk-like means rotatably mounted upon said insulating base on a substantially perpendicular axis with respect to the top surface of said base and adjacent a peripheral portion of said concentric portions of said linear conducting layer, whereby a portion of said disk-like means always overlays a part of said concentric non-intersecting linear portions, said disk-like means being formed of insulating material having a high dielectric constant, a layer of electrically conducting material on one sector of the side of the disk which is spaced from the conductive linear coating of said insulating base, conducting means electrically connecting the two layers of conducting material, the layer of conducting material on said rotatable disk being adapted to overlap different parts of the concentric portions of the linear conducting layer on said insulating base on rotation of said disk whereby the inductance of the inductive impedance as well as the capacitance between the two conducting layers is changed when said disk is rotated.

2. The device of claim 1 in which the insulating base is made of steatite.

3. The device of claim 1 in which the disk-like means is made of a mixture of titanium dioxide and magnesium titanate in such proportions as to provide a dielectric with a negligible temperature coefficient of capacitance.

4. The device as set forth in claim 1 in which the extended linear layer is in the form of a spiral and in which said base contains a hole at the inner part of the spiral, conducting means extending from the inner part of the spiral

through the hole to the opposite side of said insulating base.

5. The device as set forth in claim 1 in which the layers of conducting material comprise coating of silver.

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