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RESONANT CIRCUIT

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FIG. 1.

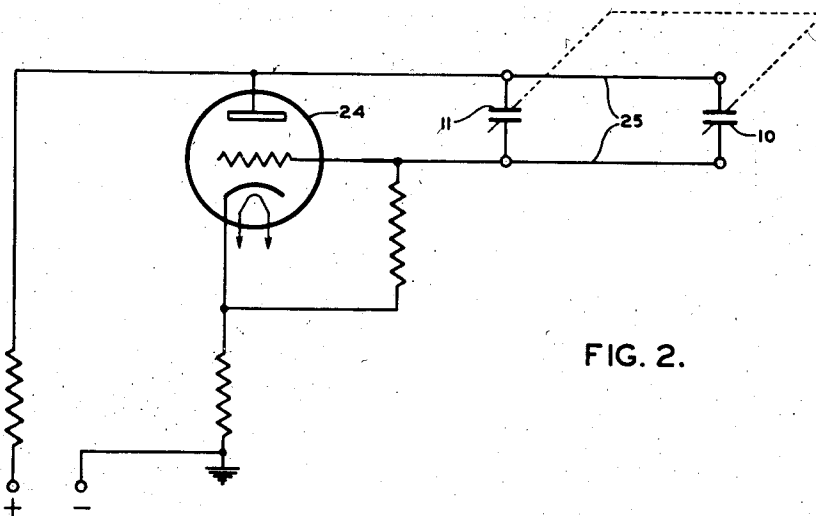
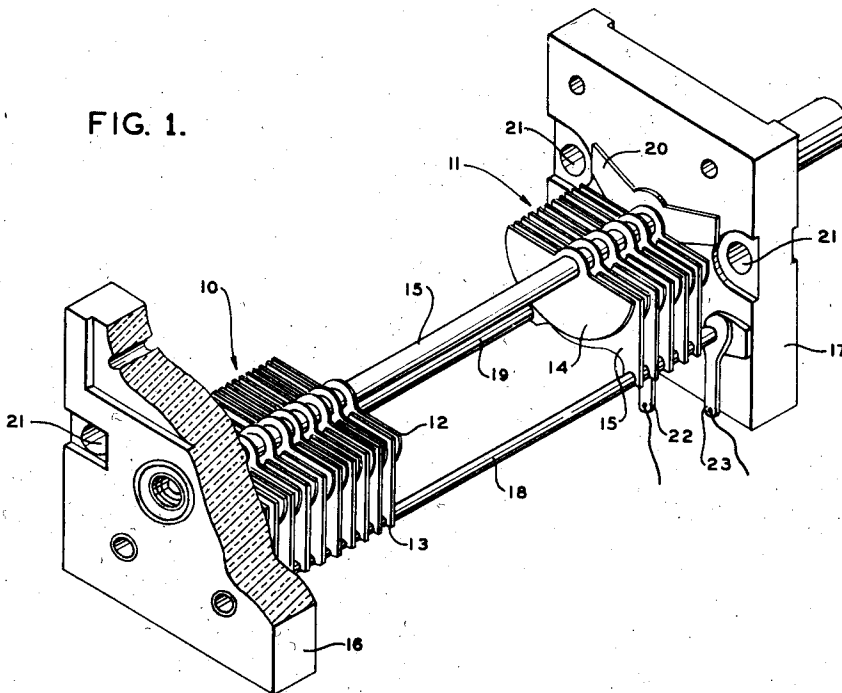


FIG. 2.

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RESONANT CIRCUIT

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4 Claims. (Cl. 250—40)

(Granted under the act of March 3, 1883, as amended April 30, 1928; 370 O. G. 757)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

The present invention relates to ultra-high-frequency tuning units for wave signal apparatus.

In parallel-resonant tank circuits comprising lumped capacitance and inductance, the common and most expedient method of tuning the tank is by varying its capacitance. The frequency range of the tank circuit lies between the minimum and maximum settings of the variable capacitor and the limiting factor in the frequency range is the value of associated inductance.

It is frequently desirable in ultra-high-frequency applications to attain a wider tuning range in a parallel-resonant circuit than can be effected through a complete sweep in the position of the shunt variable capacitor and this expansion of range can only be secured through adjustment of the inductance associated with the circuit. Since the inductance of an ultra-high-frequency tank circuit is in the order of microhenries, the use of inductive tuning entailing the use of pigtailed or sliding contacts is not feasible. Other prior art arrangements for effecting inductive tuning without sliding contacts or flexible pigtailed involve inductors of relatively large inductance, few types of which are well adapted for ultra-high-frequency tuning.

The difficulties inherent in the prior art methods of wide band tuning of lumped tank circuits at ultra-high-frequencies are in part obviated in the use of resonant transmission lines having movable shorting bridges as a tuning means. However, this tuning method is mechanically awkward and not adapted to convenient manipulation from the control panel of a commercial receiver or transmitter.

It is, therefore, an object of the present invention to provide a new and improved wide-band ultra-high-frequency tuning unit wherein the effective inductance of the circuit is varied by capacitative means.

It is another object of my invention to provide a new and improved ultra-high-frequency tuning unit in which the ratio of inductance to capacitance is maintained throughout the tuning range.

It is a further object of my invention to provide a tuning unit of the above type wherein the

components of the circuit are integrally contained in a unitary assembly.

It is still a further object of my invention to provide a new and improved ultra-high-frequency tuning unit having light weight, ruggedness, and rigidity and one readily adapted to be manufactured with close tolerances in large quantities at low cost.

In accordance with my present invention, I provide a tank circuit comprising an inductive branch in shunt relation with a capacitative branch, the combination forming a parallel-resonant circuit. The inductive branch is composed of a fixed inductor connected in series with a variable capacitor. The values of inductance and capacitance in the inductive branch are such that within the prescribed operating frequency range of said branch, the capacitative reactance of any position of the variable capacitor never exceeds the inductive reactance of the fixed inductor so that the overall impedance is inductive and in effect the branch acts as a variable inductance. The capacitative branch consists of a variable capacitor which is mechanically ganged to the variable capacitor of the inductive branch and electrically shunted across said branch. As is well known, the resonant frequency of a tank circuit is a function of its inductance and capacitance and is that frequency at which the reactance of the inductive branch is equal and opposed to that of the capacitative branch. Inasmuch as both branches, inductive and capacitative, undergo concurrent variation by means of the ganged capacitors, the frequency range encompassed by the above circuit is far broader than obtainable with conventional resonant circuits.

Moreover, since in certain applications it is desirable to maintain a specific ratio of inductance to capacitance it is of importance in wide band tuning not to substantially upset this ratio. In a power oscillator, for example, where stability is sacrificed for efficiency, the optimum LC ratio is one in which the C is relatively low. If in tuning to a desired frequency the capacity of the tank circuit is varied whereas the inductance is fixed, the tank circuit shifts between a high C and low C ratio, and the efficiency of the oscillator is thereby affected. In the present invention because of the simultaneous adjustment of the effective inductance and capacitance of the tank circuit, not only is the resonant frequency changed in large increments during adjustment but the LC ratio is not substantially altered in the process.

In a preferred embodiment of my invention, the inductor assumes the form of a transmission line whose dimensions are such as to cause the line to act inductively. Because of the low radiation resistance of such lines a far higher Q is attainable than is possible with coil inductors of the same value. In practice, I employ a pair of capacitors which are ganged together and supported by means of connecting rods. The connecting rods in addition to affording mechanical support for the structure in effect act as a transmission line while the capacitors complete the resonant circuit.

For a better understanding of the present invention, together with other and further objects thereof, reference is had to the ensuing detailed description in connection with the accompanying drawing wherein,

Figure 1 illustrates an isometric drawing of the physical structure of a preferred embodiment of my invention;

Figure 2 is a schematic circuit diagram of an ultra-high-frequency oscillator incorporating my invention.

Referring now to the drawing and more particularly to Figure 1, my invention is illustrated in a practical unitary assembly comprising a pair of variable capacitors 10 and 11, having a rotor 12, a stator 13, and a rotor 14, a stator 15, respectively. The plates of rotors 12 and 14 are affixed and ganged to a shaft 15, which is supported in bearings contained on square end-plates 16 and 17, made of insulation material such as polystyrene or a similar substance having desirable dielectric properties at ultra-high-frequencies. One end of shaft 15 extends through the bearing on plate 16, thereby enabling rotation of the shaft by a knob or similar means. A metallic spring wing 20 interposed between rotor 14 and end plate 17 maintains frictional contact therebetween and prevents slippage of the setting of shaft 15. The stators 13 and 15, which are meshed with rotors 12 and 14, are supported by connecting rods 18 and 19, the extremities thereof being rigidly secured to their respective end plates 16 and 17.

The holes 21, bored through indented portions of the end plates 16 and 17, are for the purpose of receiving machine screws for mounting the structure on a panel or chassis.

The connecting rods 18 and 19 and shaft 15 function as a transmission line and their dimensions are governed by the desired operating frequency range of the unit. Electrical connection to the tuning unit is made through soldering lug 22 which is attached to the rotor 14 of condenser 11 and soldering lug 23 which is attached to the stator 15 of condenser 11.

Referring now to Figure 2, the tuning unit is illustrated schematically as applied in a conventional ultra-high-frequency oscillator circuit employing a triode tube 24. The inductive branch of the tuning unit consists of the combination of transmission line 25 (comprising connecting rods 18 and 19 and shaft 15 in Figure 1) with capacitor 10 which serves to vary the effective inductance of the branch. Capacitor 11 is shunted

across the inductive branch and operates in parallel resonance therewith, the resonance frequency being a function of the effective inductance of the combination of capacitor 10 with line 25 and the capacitance offered by capacitor 11.

Since the condensers 10 and 11 are mechanically ganged, the effective inductance and capacitance of the tank is simultaneously varied so that the overall frequency change is far greater than attainable by a variation of a simple condenser in a tank circuit. Moreover since the effective inductance is varied in coordination with the variation in tank capacitance, the LC ratio is not substantially disturbed throughout the tuning range.

It will be apparent that various modifications and changes may be made without departing from the spirit and scope of the invention provided such modification and changes fall fairly within the spirit and scope of the claims hereinafter appended.

I claim:

1. The combination in a parallel-resonant circuit comprising an inductor having capacitive means for varying the effective inductive reactance thereof, and a variable capacitor mechanically ganged to said capacitive means and electrically shunted across said inductor whereby changes in the value of said capacitor are accompanied by changes in the value of said inductor.

2. The combination in a parallel resonant circuit comprising a transmission line of a length adapted to act as an inductance within a prescribed frequency range, a first variable capacitor shunted across one end of said line for varying the effective length thereof, a second variable capacitor shunted across the other end of said line in parallel resonance therewith, and mechanical means for ganging said first and second capacitors.

3. The combination in a parallel-resonant circuit comprising a first variable capacitor, a second variable capacitor colinearly disposed in respect to said capacitor, and a transmission line connecting said capacitors in parallel, one conductor thereof mechanically ganging said capacitors.

4. In a resonant structure the combination comprising a pair of spaced end plates in parallel relation, each having a central bearing, a pair of parallel rods connecting said end plates, a shaft extending between said bearings, a first variable condenser having its stator mounted across said rods at one end thereof and its rotor mounted at one end of said shaft, and a second condenser having its stator mounted across said rods at the other end thereof and its rotor mounted at the other end of said shaft whereby said first and second condensers may be simultaneously varied, said rods and said shaft being arranged as to form a transmission line of a length adapted to act as an inductance within a prescribed frequency range, whereby said line in combination with said first and second condensers form a parallel resonant circuit.

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