July 5, 1949. W. R. KOCH 2,475,032

VARIABLE PERMEABILITY TUNING SYSTEM

Filed March 17, 1945

Fig. 1.

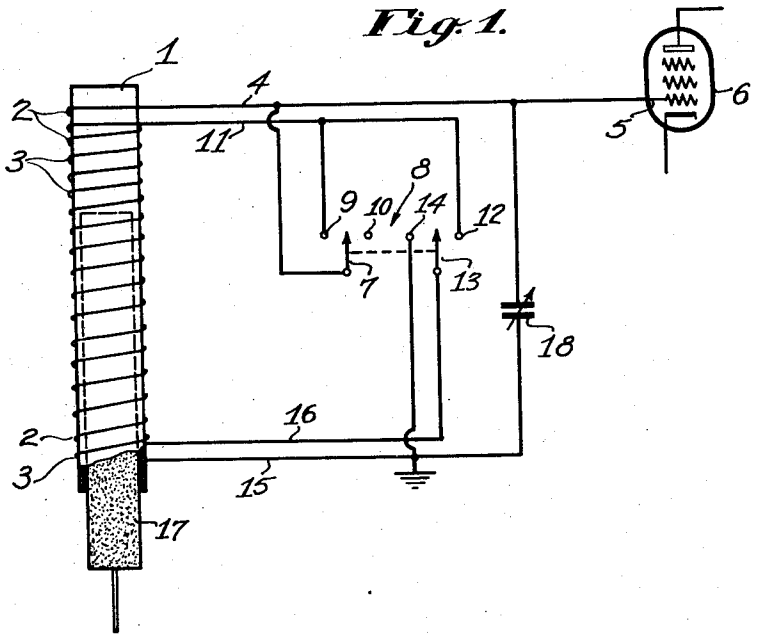


Fig. 2.

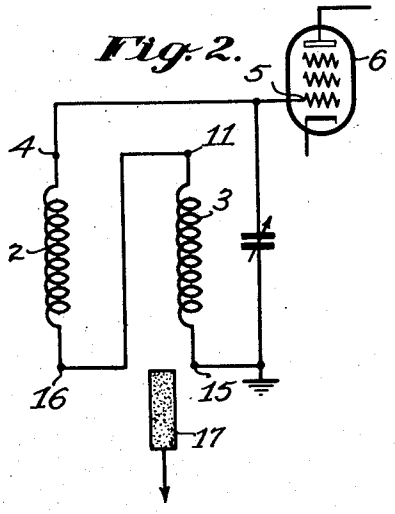
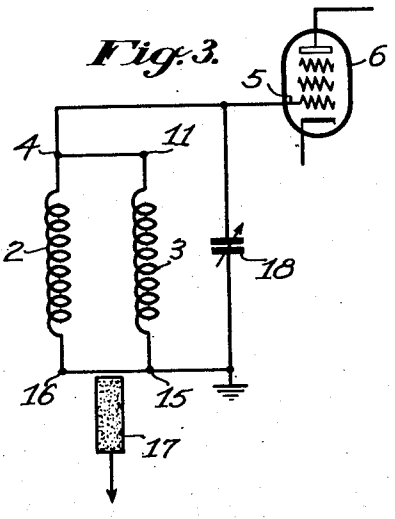


Fig. 3.



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Patented July 5, 1949 2,475,032

UNITED STATES PATENT OFFICE

2,475,032

VARIABLE PERMEABILITY TUNING SYSTEM

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Application March 17, 1945, Serial No. 583,214

4 Claims. (Cl. 250—40)

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My present invention relates to a variable permeability tuning system, and more particularly to a permeability tuner in which the same coil and core structure is utilized in multi-band receivers for tuning the same through different frequency ranges.

It is known, in order to effect permeability tuning in different frequency ranges, to shunt the main tuning inductance with a second tuning reactance. If the shunting reactance is an inductance, the frequency range capable of being covered at higher frequencies (due to the lowered effective inductance of the two coils in parallel) will be greatly reduced as compared to the frequency range covered by the main tuning inductance alone at lower frequencies. If the shunting reactance is a fixed capacitor, the L/C ratio becomes poor. According to the present invention, the construction is greatly simplified by providing, as the permeability tuned inductance, a pair of windings in bifilar relation which are arranged to be connected in series and also in magnetically aiding relation for the lower frequency range and in parallel, magnetically aiding relation for the higher frequency range. According to this arrangement a wide range is covered for both bands with a good L/C ratio in each case.

It is therefore one of the objects of the invention to provide, in a multi-band receiver, an improved tunable circuit which is adapted for use in different bands and in which tuning in any of the bands is accomplished by an adjustable ferromagnetic core without switching in auxiliary inductances or capacitors.

Another object of the invention is to provide a simple permeability tuner for multi-band receivers which employs a bifilar coil and an adjustable iron core cooperatively related therewith, the coil windings being connected in series-aiding for one band and in parallel-aiding for another band.

A further object is to provide a resonant circuit which comprises a capacitor, an inductor formed by winding two wires of equal size simultaneously side by side on a coil form, a magnetic core having an adjustable position for changing the inductance of said windings, and a switch for connecting said windings in either series-aiding or parallel-aiding relation, the distributed capacity of said windings and that of said capacitor having such relation that the resonant frequencies obtainable with the switch in one position do not substantially overlap those obtainable with the switch in the other position.

The novel features characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and mode of operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawings in which:

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Fig. 1 discloses in schematic fashion a permeability tuner constructed in accordance with the present invention, and

Figs. 2 and 3 show, respectively, the connections of the bi-filar windings when switched to operate in their respective low frequency and high frequency bands.

Referring to Fig. 1 there is shown at 1 a tubular coil form of suitable insulating material on which a pair of bi-filar windings 2, 3 are wound in the same direction. Preferably, the windings are single-layer solenoid windings having the same length and diameter, and with equal spacing between adjacent turns. The high potential end 4 of winding 2 is adapted to be connected to the signal grid 5 of an electron discharge tube 6 which may be either the radio frequency amplifier or the converter stage of a radio receiver. This end of winding 2 is connected also to the movable arm 7 of a band change switch generally indicated by the reference character 8. Associated with the switch arm 7 are a pair of contacts 9 and 10, the former being connected to the adjacent high potential end 11 of winding 3, while contact 10 is blank. High potential end 11 of winding 3 is connected also to a contact 12 of a second switch arm 13 which is unicontrolled with switch arm 7. A second contact 14 associated with arm 13 is connected to the low potential end 15 of winding 3 which is connected also to ground, and switch arm 13 is connected to the low potential end 16 of winding 2.

The bi-filar windings 2 and 3 have associated with them an adjustable ferro-magnetic tuning core 17 which enters the coil form 1 at the low potential end of winding 3, suitable means, not shown, being provided for the purpose of adjusting the axial position of the core and thereby tuning the circuit to desired frequencies within each of the two bands hereinafter described. A trimmer condenser 18 is connected between the high potential end 4 of winding 2 and ground, or the low potential end 15 of winding 3.

For conditioning the tunable circuit (windings 2, 3 and capacitor 18) for operation in one frequency band, change switch 8 is actuated to the right, as viewed in Fig. 1, in which case, as shown in Fig. 2, the bi-filar windings are connected in series-aiding relation. For conditioning the tun-

able circuit for operation in a higher frequency band, change switch 8 is actuated to the left in which case, as shown in Fig. 3, the bi-filar windings are connected in parallel-aiding relation. For effecting operation in still other frequency bands, there may be provided one or more additional windings together with suitable switching means for selectively connecting the coils in series-aiding or parallel-aiding relation. By the term "aiding" relation it is meant that the magnetic fields of the several coils are additive or in the same direction.

For good Q (figure of merit), in series-aiding connection (Fig. 2), the inductor preferably should be wound on a low-loss form, with bare wire, spaced, and coated with low-loss coil dope. It should be noted that in the series-aiding connection, the distributed capacity is much larger than in the parallel-aiding connection because the distributed capacity between windings becomes effective. This may be useful in keeping the two ranges from overlapping, if capacitors are not switched when changing ranges. The number of turns is effectively changed 2–1 which results in almost 4–1 inductance change, in switching the connections. If a 9–1 inductance change occurs due to moving the core, corresponding to a 3–1 tuning frequency range, the shunting capacitor must be changed 2.25 to 1 when changing connections, in order to avoid overlap. However, by proper circuit and coil design, the distributed capacity of the coil will automatically give this change, without change in the shunting capacitor. With the parallel-aiding connection, the effective Q of the coil is of course much better than if only one of the windings were used. The tuning range, also, is greater with the parallel connection than if only one winding were used.

While I have shown and described a preferred embodiment of my invention, it will be understood that various modifications and changes will occur to those skilled in the art without departing from the spirit and scope of this invention. I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim is:

1. A tuning device comprising a pair of inductance coils of substantially equal inductive value and coaxially arranged on an insulating form in bifilar relation, single means for tuning said device over either of two frequency bands, and switch means for selectively connecting said coils in series-aiding relation with a substantial difference in potential between adjacent turns of the coils, respectively, for operating the device in one frequency band and in parallel-aiding relation for operating the device in a different frequency band.

2. A permeability tuning device comprising a pair of windings wound in bifilar relation on an insulating form, a magnetic core axially movable within said form, and switch means for selectively connecting said windings in series-aiding relation with a substantial difference in potential between adjacent turns of the windings, respectively, for operating the device in one frequency band and in parallel-aiding relation for operating the device in a different frequency band.

3. A permeability-tuned circuit adapted for use in multi-band radio receivers, comprising a pair of coaxially arranged windings wound in bifilar relation on an insulating form in the same direction, a magnetic core axially movable within said form, switch means and connections therefrom to the winding terminals whereby in one position of said switch means the windings are connected in series-aiding relation with a substantial difference in potential between adjacent turns of the windings, respectively, for conditioning the circuit to be tuned through one frequency band by adjustment of said magnetic core, and in another switch position the windings are connected in parallel-aiding relation for conditioning the circuit to be tuned through a different frequency band by adjustment of said magnetic core.

4. A permeability tuned circuit as defined in claim 3, wherein the windings whether connected in series-aiding or in parallel-aiding are shunted by the same fixed trimmer capacitor, said capacitor being connected permanently between a high potential terminal of one of said windings and a low potential terminal of the other of said windings.

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