Aug. 16, 1949. I. J. KAAR 2,479,368

VARIABLE TUNING ARRANGEMENT

Filed Oct. 21, 1947 2 Sheets-Sheet 1

Fig. 1.

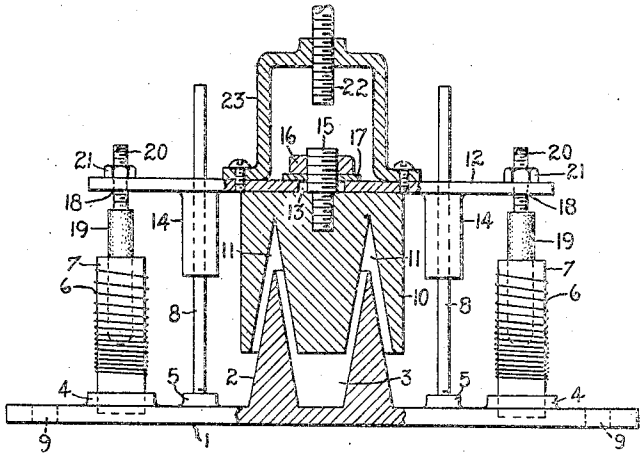


Fig. 2.

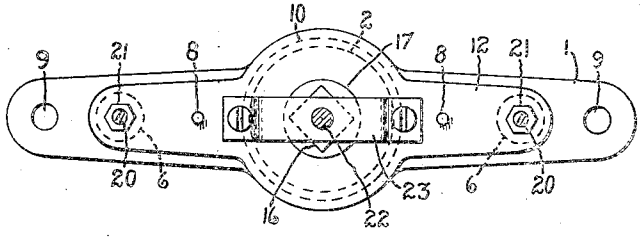
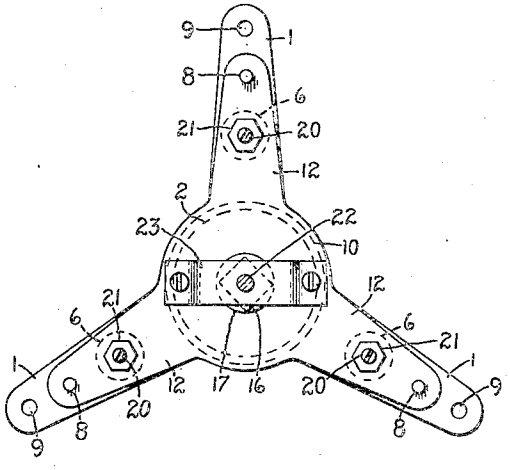


Fig. 3.



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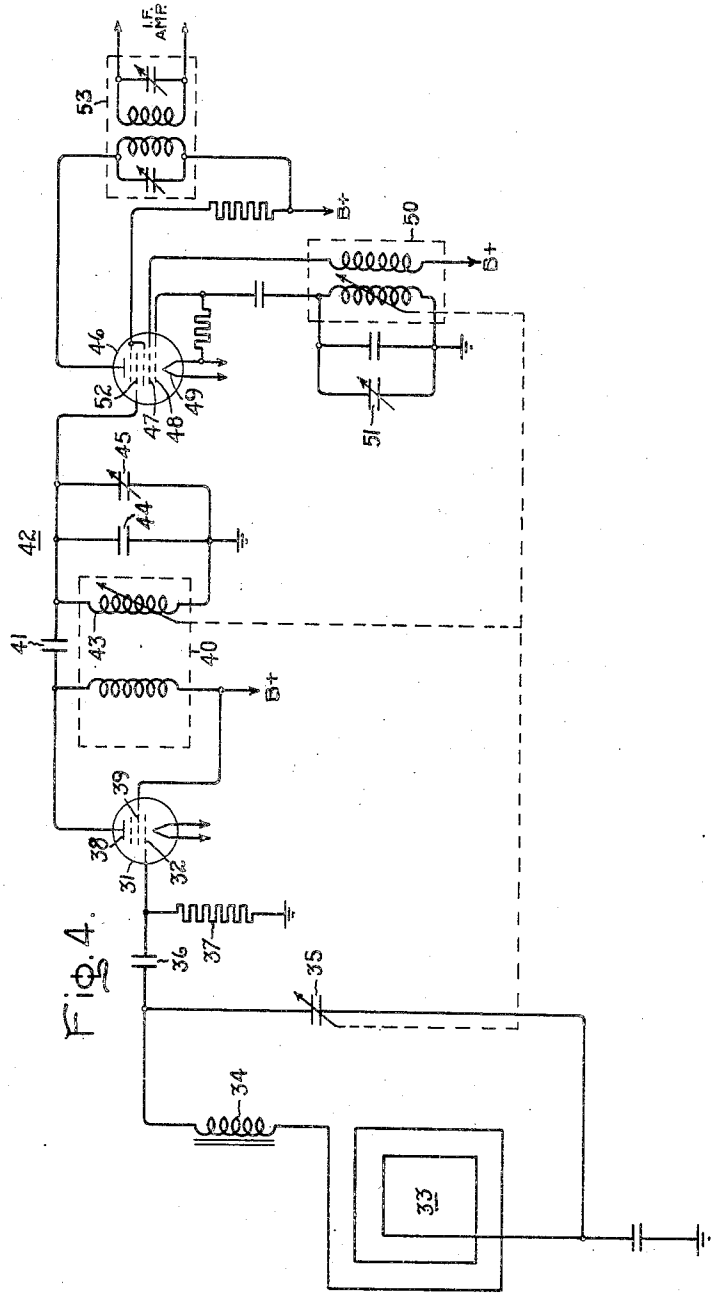

Fig. 4.

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VARIABLE TUNING ARRANGEMENT

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2 Claims. (Cl. 250—40)

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My invention relates to variable tuning arrangements for radio receivers and similar apparatus, and more particularly, to a variable tuning arrangement for the signal input and converter-oscillator circuits of a superheterodyne receiver. It is a primary object of my invention to provide a compact arrangement of this type obtaining improved performance characteristics of such a receiver.

It is a customary practice in superheterodyne receiver design to employ a loop antenna in conjunction with a variable capacitor as a selective signal pickup device. The local oscillator may be tuned either by a variable capacitance or by one or more variable inductances. A capacitance-tuned local oscillator, however, has a tendency to produce a "howl" or "squeal" in the output circuit of the receiver, due to the susceptibility of the capacitor vanes to vibration. It has been found that the use of an inductance-tuned local oscillator results in a reduction of the "howl" tendencies of the receiver. It has also been found advantageous to use a capacitance to tune the loop circuit of a receiver for reasons of enhanced sensitivity. Hence, it is desirable to employ a variable tuning arrangement comprising a variable capacitor element, for tuning the loop circuit, which operates simultaneously with one or more variable inductor elements, for tuning the local oscillator circuit, in such a way as to effect perfect tracking. It is a particular object of my invention to provide such a variable tuning arrangement.

Another object of my invention is to provide means of simultaneously tuning a capacitor in one circuit and a plurality of inductors in one or more associated circuits in such a way that the respective frequencies of the circuits involved maintain a predetermined relationship to each other throughout the tuning range.

A further object of my invention is to provide reliable and convenient means for setting up and maintaining the desired tracking relationship between the associated circuits at reduced cost.

The features of my invention which I believe to be novel are set forth with particularity in the appended claims. My invention itself, however, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 is a side elevation, partly in transverse section, of a variable tuning arrangement suitably embodying my invention; Fig. 2 is a partial plan view of the same arrangement; Fig. 3 is a partial plan view of another modification; and Fig. 4 is a schematic circuit diagram illustrating an application of my invention to a superheterodyne radio receiver.

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Referring to Fig. 1, a die-cast metal supporting member 1, preferably of aluminum or other light conducting material, is provided integrally with a protruding truncated cone-like structure 2 which constitutes the stator or stationary element of a variable capacitor. The stator 2 is provided with an axial recess 3, also shaped like a truncated cone, but inverted with respect to the outer structure 2. Also die-cast as integral parts of the supporting member 1 are two coil form support bushings 4 and two guide rod support bushings 5. One or more coils 6 having suitable inductance characteristics are mounted on respective hollow coil forms 7 of suitable insulating material which are rigidly inserted and fixed in each of the support bushings 4. Illustrations of the connection terminals for the coils 6 are omitted in order to simplify the drawing. The support bushings 5 are provided with round metal guide rods 8 which are rigidly attached therein. The supporting member 1 is also provided with mounting holes 9 by which means supporting member 1 is maintained in a fixed position relative to the chassis.

A substantially cylindrical structure 10 is provided having a hollowed-out annular recess 11 of such shape as to permit structure 10 to mate axially with the stator 2. This structure 10 is die-cast of the same material as the stator 2 and constitutes the rotor of the aforementioned variable capacitor. I also provide a second die-cast supporting member 12, having a centrally located hole 13, and comprising as integral parts thereof a pair of elongated guide rod bushings 14, so positioned that when the guide rods 8 are inserted therein, the hole 13 in member 12 is in substantially coaxial alignment with the stator 2. The bushings 14 are so proportioned as to fit the guide rods 8 as snugly as possible consistent with allowing longitudinal motion thereon.

In order to insure perfect axial alignment between the stator 2 and the rotor 10, means are employed for laterally adjustably fastening the rotor 10 to the second supporting member 12. Such means as shown take the form of a threaded stud 15, of smaller diameter than hole 13 in member 12, permanently fastened to the rotor 10. An adjusting nut 16 then fastens the rotor 10 to member 12; the customary washer 17 is provided. In order to center the rotor 10, the adjusting nut 16 is loosened and the entire

assembly comprising rotor 10 and member 12 is placed in its extreme downward position. Since the clearance hole 13 is of larger diameter than the threaded stud 15, the rotor 10 is permitted to move laterally until it exactly mates with the stator 2. In this position, the adjusting nut 16 is tightened, thus insuring perfect axial alignment of the rotor 10 with the stator 2.

Member 12 with two threaded holes 18 is located coaxially with the coil from support bushings 4 when the guide rod bushings 14 are fitted over the guide rods 8. I supply two elongated compressed powdered iron cores 19, each fitted with a threaded shank or stud 20 of suitable dimension to thread into holes 18. This expedient provides means for positioning the cores 19 relative to the rotor 10 of the variable capacitor, and thus effects an initial tracking relation between the associated circuits. Lock nuts 21 are supplied to secure the positions of the cores 19 relative to the rotor 10 after making the initial tracking adjustments.

Likewise, means are provided for moving the supporting members 1 and 12 with respect to each other so that a single operating shaft 22 may be used to obtain simultaneous adjustment of inductance and capacitance. Such means are shown comprising a yoke 23 fastened to member 12 and straddling the adjusting nut 16. Members 1 and 12 are relatively positioned by rotation of the operating shaft 22.

Fig. 2 is a partial plan view of the arrangement shown in Fig. 1 which, taken in connection with Fig. 1, defines more exactly the shapes of the rotor 10 and the stator 2 of the variable condenser. Fig. 3 shows a modification of my invention in that three tunable coils 6 are provided instead of two, as in Figs. 1 and 2. Like reference numerals indicate similar elements in Figs. 1, 2 and 3.

In the circuit of Fig. 4, a high-vacuum pentode 31, or other suitable electron discharge device, is employed as a radio-frequency amplifier in a superheterodyne receiver. The signal input grid 32 of device 31 is connected to a signal input circuit comprising an inductive loop antenna 33, together with the customary antenna loading coil 34, in shunt with a variable tuning capacitor 35, such capacitor comprising the rotor 10 and stator 2 (Fig. 1) of my invention. Capacitor 36 and resistor 37 are the customary coupling condenser and grid leak resistor respectively. The anode 38 of device 31 is connected through the primary winding of a singly-tuned radio frequency transformer 40 to the direct plate supply voltage, indicated by the legend B+. The screen electrode 39 of device 31 is connected directly to B+. The inductance-capacitance network comprising the primary of the radio frequency transformer 40 and a coupling capacitor 41 passes substantially all signal input frequencies to the tuned circuit 42, as is well known in the art. Tuned circuit 42 comprises the secondary 43 of the radio frequency transformer 40, which is tuned by means of an adjustable iron core, not shown, and a parallel capacitance 44, and is provided with the usual trimmer condenser 45.

A high-vacuum heptode 46 is employed as a converter-oscillator device, the oscillator anode, grid and cathode elements of which are located at 47, 48, 49 respectively. The local oscillator is inductance-tuned by means of an oscillator coil 50 shunted by a trimming condenser 51. This inductance of coil 50 is variable over a suitable operating range by means of a conventional powdered iron core (not shown) and comprises one of the variable inductances heretofore described.

The amplified radio frequency signal is supplied, through the radio frequency transformer 40, to the mixer grid 52 of device 46. The output of device 46 is connected through the customary intermediate frequency transformer 53, to an intermediate frequency amplifier (not shown). Further description of the circuits of the receiver and elements thereof is believed to be unnecessary, since the circuit shown illustrates a present preferred use for my invention.

In the circuit of Fig. 4, my variable tuning arrangement is used to tune conjointly the antenna, radio-frequency, and local oscillator stages of a superheterodyne receiver, the tuning elements being mechanically connected as indicated for unicontrol operation, and comprising the variable capacitor and the tunable coils 6 of Fig. 1. In some cases, the trimming condensers 45, 51 may be eliminated, thus obtaining economy of parts, the initial tracking relationship being effected entirely by positioning the iron cores 19 with respect to the rotor 10 of the variable capacitor.

The variable capacitor shown effects linear capacitance tuning; therefore, for perfect tracking, linearly tunable inductances are required. Such linear tuning in the radio-frequency and local oscillator circuits may be obtained by making the coils 6 (Fig. 1) of variable pitch, or by other suitable means.

Although my invention has been described in its present preferred application to the tuning system of a superheterodyne receiver, it is understood that various modifications may be made. The appended claims are intended to cover all equivalent modifications coming within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. In combination, a pair of juxtaposed metallic members, one of said members having an integral truncated cone-shaped portion extending toward the other member, said portion having a centrally positioned truncated cone-shaped recess, a cylindrical structure laterally adjustably fastened to said other member and extending toward said one member, said structure having an annular recess having walls parallel respectively to the walls of said portion and said cone-shaped recess, a pair of bushings integral with said other member with bores having axes parallel with the axis of rotation of said annular recess, a pair of guide rods rigidly connected to said one member and respectively engaging different of said bores, said rods and bushings being so positioned that the axes of said structure and said portion are coincident, a pair of tubular coil forms supported on a first of said members, windings positioned on said forms, a pair of magnetic cores adjustably supported on the second of said members, said cores respectively being arranged to enter into different of said forms, said forms and said cores having longitudinal axes parallel with said coincident axes, the axes of corresponding of said forms and cores being coincident, said portion and said structure forming an electrical capacitance, and means whereby the relative positions of said portion and said structure may be varied along their said axes to adjust the value of said capacitance and the inductance of said windings.

2. In a radio receiver having a plurality of resonant circuits tunable over a band of frequencies, one of said circuits comprising a vari-

able capacitance and a pair of said circuits comprising variable inductances, said variable capacitance comprising a pair of rotationally symmetrical mating members having coincident axes, one of said members having a truncated cone-shaped outer surface and a centrally positioned truncated cone-shaped recess, a structure having an annular recess laterally adjustably fastened to the other of said members, a respective base portion attached to each of said members, a pair of guide rods attached to the base portion of a first of said members and extending parallel to said axes, a pair of bushings integrally attached to the second of said members and having bores adapted to engage said rods, said inductances comprising a pair of windings supported from the base portion of one of said members and a pair of substantially cylindrical iron cores supported from the base portion of the other of said members, said cores respectively being arranged

to enter into different of said windings, the position of one of said cores being adjustable relative to the base portion of said other member to adjust the inductance of the windings associated therewith, and means whereby the positions of said members may be varied along said coincident axes to adjust the value of said capacitance and the inductance of said windings.

IRA J. KAAR.

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