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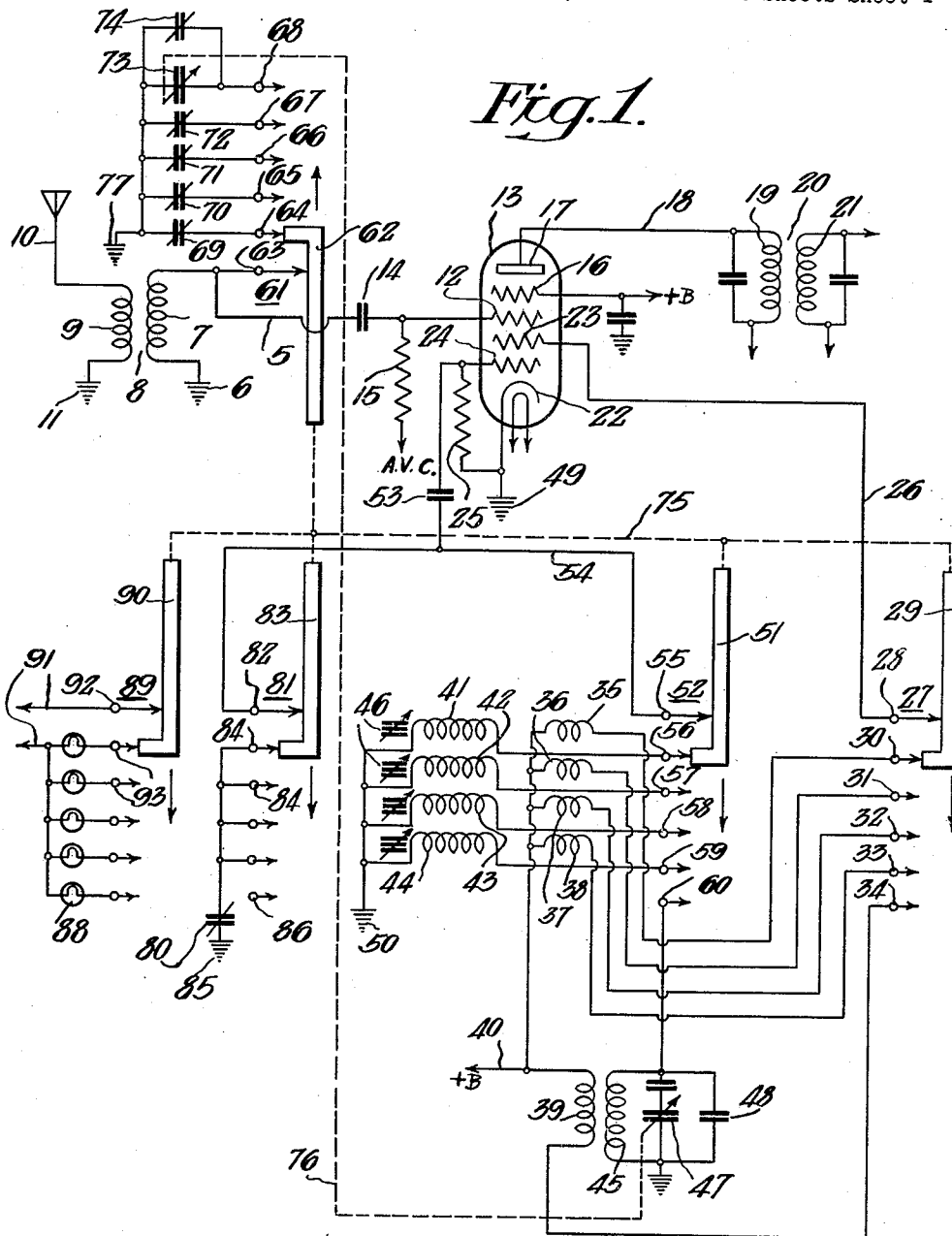
K. A. CHITTICK ET AL

2,209,959

RADIO RECEIVING SYSTEM

Filed March 31, 1938

2 Sheets-Sheet 1



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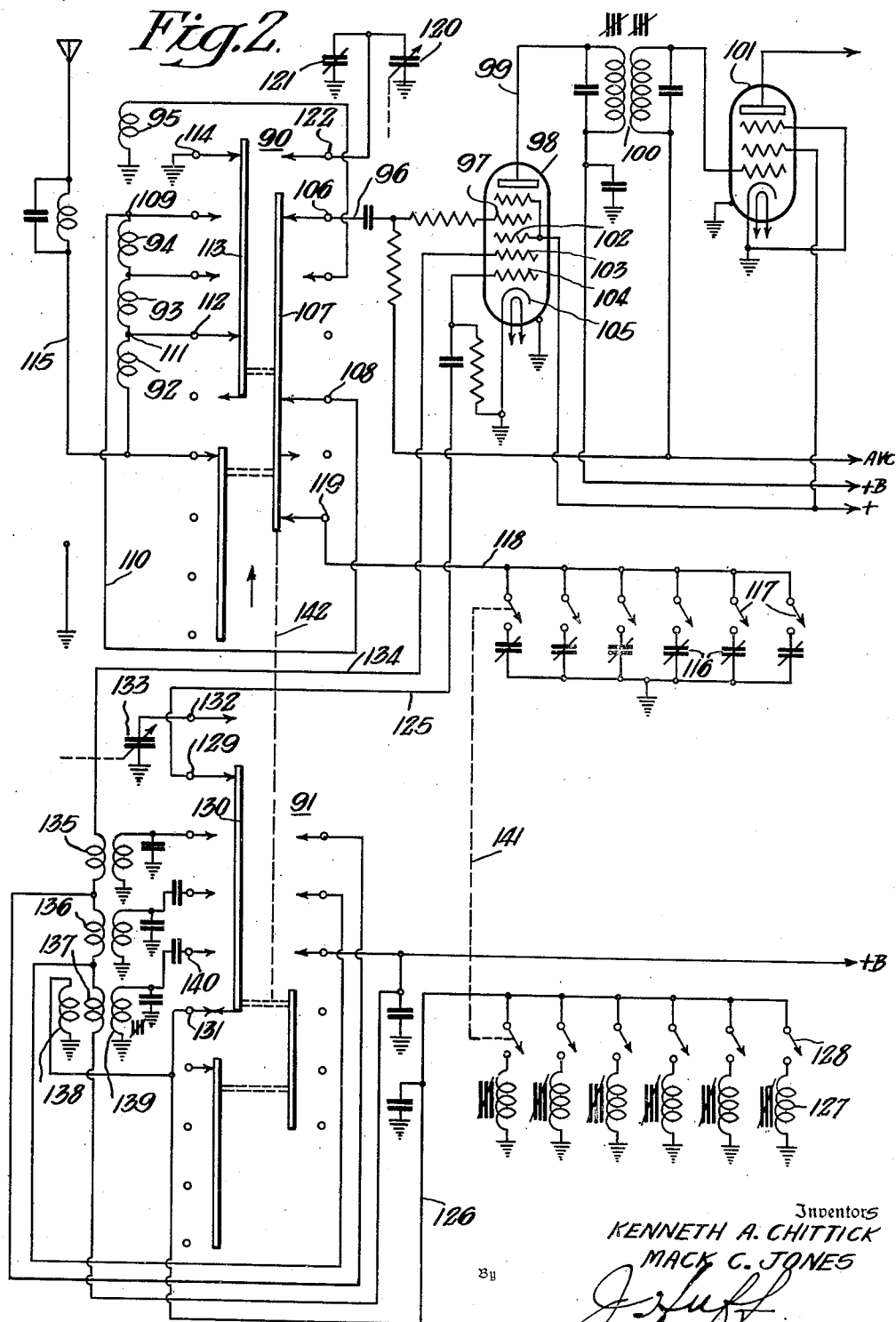
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RADIO RECEIVING SYSTEM

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6 Claims. (Cl. 250—20)

The present invention relates to radio receiving systems and more particularly to receiving systems of the superheterodyne type, comprising a tunable oscillator circuit and a tunable signal receiving circuit in connection with the first detector. These circuits are jointly tunable by uni-control tuning means, such as a multiple unit variable capacitor in connection with the inductance elements of the two circuits to produce the desired intermediate frequency.

It is an object of the present invention to provide a radio receiving system of the type above referred to which may be tuned variably through a predetermined tuning range and which may be tuned selectively to any one of a plurality of preselected signal frequencies within or without that tuning range.

In applying this system to broadcast receivers, the system is tunable throughout the broadcast range by variable tuning means and is also arranged to be preadjusted for response in a plurality of selectable points at differing frequencies within that tuning range, whereby the receiving system may be made to respond to a plurality of preselected signal channels or broadcasting stations instantly by push-button or similar control means for switching into circuit various pre-adjusted tuning elements.

The preadjusted tuning elements for oscillator and signal receiving circuits of a superheterodyne receiver provided by the present invention permit a further object of the invention to be carried out in that the circuits for preselection of a plurality of signal channels are simplified and adapted for compact mounting within a receiver chassis with the adjustment means grouped for ready adjustment in one location.

In providing for the control of a preselection system, consideration must be given to stability of operation over long periods of time without additional adjustment of the pretuned circuit elements, and a simplification of the switching operations involved. Accordingly, it is a further object of the present invention to provide an improved radio receiving circuit of the type referred to wherein the selective switching operations may be simplified and stability of operation may be improved.

It is also an object of the present invention to provide a superheterodyne radio receiving system having simple means for presetting the same for response in a plurality of preselected signal channels and for automatically tuning said system to each of said preselected channels au-

tomatically upon operation of any one of a plurality of push-button controls or other suitable selecting means in connection with a simplified circuit arrangement therefor.

The invention will, however, be better understood from the following description, when considered in connection with the accompanying drawings, and its scope will be pointed out in the appended claims.

In the drawings—

Figure 1 is a schematic circuit diagram of a radio receiving system embodying the invention, and

Figure 2 is a similar schematic circuit diagram of a radio receiving system embodying the invention and provided with a modification of the selective switching system shown in connection with Fig. 1.

Referring to Fig. 1, the receiving system, of the superheterodyne type, is provided with a signal input or receiving circuit 5—6 in which there is connected the tunable secondary winding 7 of a signal input or antenna coupling transformer 8, the primary 9 of which is coupled to an antenna and ground system 10, 11 for collecting and receiving signals.

The low potential side of the signal input circuit 6 may be grounded to the chassis as indicated and the high potential side 5 is connected to the control grid 12 of a combined first detector and oscillator tube 13 through the usual coupling capacitor 14 and grid resistor 15.

The tube 13 is provided with a screen grid 16, an output anode 17, the latter being connected with an output anode circuit 18 and with the tuned primary 19 of an intermediate frequency amplifier input transformer 20, which may be coupled through the tuned secondary 21 to the usual intermediate frequency amplifier (not shown), and the remainder of the receiving system, which does not concern the invention and is therefore not illustrated.

While any suitable oscillator may be utilized, in the present example, the oscillator tube elements are included within the tube 13 and comprise a cathode 22 in common with the detector, a grid element 23 functioning as a plate for the oscillator, and a control grid 24 located between the cathode and the grid element 23, the grid 24 being connected back to cathode through the usual grid resistor 25, as shown.

The oscillator is preferably of the feedback coil type employing tuned grid circuits and anode circuit feedback coupling thereto. In the present example, the oscillator anode electrode 23

is connected with an anode circuit 26, which is completed through a selector switch section 27, comprising a fixed contact 28 for the circuit 26, a movable contact element 29, which selectively and consecutively engages other fixed contacts indicated at 30—34, inclusive, for completing the anode circuit 26 through feedback coils indicated at 35—39, inclusive, all of the coils being connected at the low potential sides to a positive anode potential supply lead indicated at 40.

Each of the feedback coils 35—39, inclusive, is coupled with one of a series of tunable oscillator grid circuit inductances, indicated at 41—45, inclusive, certain of which are tuned by means of adjustable cores 46 of magnetic material and one of which, 45, is tunable by means of a variable tuning capacitor section, indicated at 47, in shunt therewith, together with a trimmer capacitor, indicated at 48.

The various grid circuit inductances are returned to the cathode 22 which is grounded, as indicated at 49, through a ground connection, indicated at 50.

In step with the switch section 27 and the movable contact element 29 thereof, is a second movable contact element 51 in a second section 52 of the switch, which serves to connect the grid circuit of the oscillator through the grid capacitor 53 and a connecting lead 54 selectively with the inductances 41—45, inclusive, through a fixed contact 55 connected with the lead 54 and engaging the contact 51, and a series of fixed contacts 56—60, inclusive, for the successive inductances 41—45, respectively.

In the positions shown in the drawings, the switch elements 29 and 51 provide a grid connection for the oscillator grid 24 through the contacts 55 and 56 with the inductance 41 which is adjustable by the core 46 to any predetermined frequency within a selected range of signal frequencies, such as the standard broadcast band, differing therefrom by the amount of the desired intermediate frequency, and the anode circuit 26 is coupled to this inductance through the connections provided by the contacts 28 and 30 and the feedback winding 35, which is coupled to the winding 41 as indicated.

The oscillations established on the oscillator grid 24 are electronically coupled to the oscillations supplied by the signal receiving circuit to the first detector or mixer grid 12, and the resulting intermediate frequency is transferred through the output circuit 18 to the intermediate frequency amplifier through the coupling provided by the tuned coupling means 20.

Each of the others of the plurality of tuning inductances 42—44, inclusive, are similarly adjusted to provide oscillator frequencies for heterodyning predetermined signals to the desired intermediate frequency, by means of the adjustable cores, while the inductance 45 is variably tunable by the variable capacitor section 47 throughout a predetermined range, such as the entire broadcast range for manually tuning the receiver.

For tuning the signal input circuit, a third section 61, of the selector switch, is provided with a movable contact element 62 in connection with a fixed contact 63 for the high potential side 5 of the signal input circuit, and a series of fixed contacts 64—68 for selective connection with the movable contact 62 to place in shunt with the circuit 5—6 and the secondary winding or inductance element 7 one of a series of adjustable capacitors 69—72, inclusive, and a manually varia-

ble tuning capacitor section 73 having a shunt trimmer capacitor 74.

As shown in the drawings, the switch section 62 provides connection for the capacitor 69 in shunt with the winding 7 to tune the signal input circuit to a signal channel or broadcasting station, the frequency of which beats with the then adjusted oscillator frequency established by the winding 41 and the feedback winding 35 to produce the desired intermediate frequency for receiving that signal channel or station.

The switch sections 29, 51 and 62 are interconnected as indicated by the dotted connection 75 to move progressively step by step through the successive contacts, from the initial positions shown through the contacts consecutively and in step, whereby a plurality of preselected broadcasting stations or signal channels may be received by the system in accordance with the adjustment of the selector switch, and with the final step, in this case the fifth, providing for manually tuning the receiving system throughout the broadcast band or other selected frequency band by means of the variable capacitors 73 and 47. As in the usual receiving system the capacitors 73 and 47 are interconnected for joint control as indicated by the dotted connection 76.

In this receiver arrangement, the adjustable capacitors 69—72 for the signal input circuit or first detector and the adjustable inductances 41—43 for the oscillator circuit, are arranged in close spaced relation to each other in a convenient location on the receiver chassis for adjustment all at one time. It will be seen that this may be done for the reason that the adjusting means for the oscillator, while comprising small inductance elements, does not require shielding from and may be located adjacent to the tuning adjustment elements of the input circuit which are of a different type, being capacitors and not adapted for inductive coupling with the inductance elements of the oscillator when positioned adjacent thereto in such a manner as to make the tuning adjustment for both circuits available at one place on the chassis. It should be understood that the spacing of the tuning elements for the two circuits is normally sufficient to prevent stray capacity coupling as is the usual case with the various circuit components in a usual radio receiver chassis. The inductive coupling, however, is prevented since the inductance tuning control elements are utilized only in the oscillator circuit for stabilizing tuning thereof. In other words, the normal spacing between the elements in the group with the usual mounting arrangements for such elements is beyond the limit for any stray capacity coupling as has been found in the construction and operation of the system shown. The provision of capacity tuning adjustment in one circuit and inductive tuning adjustments in the other circuit inherently precludes inductive coupling.

This clearly simplifies the tuning system, the adjusting means and the receiver assembly and permits the system to be applied to small low cost receivers.

It will further be noted that the adjusting means for the oscillator comprising the cores 46, are located at the grounded ends thereof and the adjustment thus does not disturb the coupling between the inductances and the feedback windings therefor and the adjusting operation does not appreciably affect the tuning. Likewise, the capacitors 69—72, inclusive, are adjusted in connection with the grounded electrode thereof as

it will be noted that these capacitors are all connected at one electrode in parallel, to chassis or ground, as indicated at 77.

From the foregoing description, it will be seen that in a superheterodyne receiving system, the signal receiving and oscillator circuits may be arranged for simplified switching and adjustment to provide manual tuning, and in addition, automatic or preselection tuning, by changing the circuit tuning elements of the signal receiving circuit and oscillator, which elements, in the one, are capacitive and, in the other, are inductive, whereby the capacitive and inductive elements may be associated sufficiently close together for adjustment at one place without undesired coupling effects as hereinbefore referred to. Furthermore, in the tuning of the oscillator circuits by means of separate inductances having movable magnetite cores for each individual wave band in the tuning range to be preselected, permanent tuning adjustment may be obtained and accurate alignment of the receiving system to the desired signal frequencies may be obtained.

The switching device is shown diagrammatically in one of its simplified forms as comprising three movable elements, one for changing the capacitors in connection with the signal input circuit, another for changing the oscillator tuning inductances in the grid circuit of the oscillator, and a third for changing the feedback windings associated with the oscillator tuning inductances.

To these elements may be added other switching elements for additional purposes in the receiver, such, for example, as the addition of a trimmer or additional tuning capacitor indicated at 80, for the oscillator grid circuit, which is connected to the circuit lead 54 through a switch section 81 comprising a fixed contact 82 with which there is associated a movable contact element 83 selectively connectable to fixed contacts 84 in parallel. The contacts 84 are connected with the capacitor 80 which is grounded as indicated at 85, thereby placing it in parallel with the successive inductances 41 to 44, inclusive.

In the fifth position of the switch, the contact 86 is left open circuited in order that the variable tuning capacitor 47 and the trimmer capacitor 48 may become effective to control the tuning independently of the capacitor 80. The switch section 81 is uni-controlled with the other sections by placing the movable element 83 in connection with the other elements, as indicated by the dotted connection with the line 75.

In addition, pilot lamps 88 or other suitable indicating means may be provided for indicating the various signal channels or stations and the manual tuning position through the operation of a fifth switch section 89, the movable contact element 90 of which is uni-controlled with the others and serves to connect low voltage supply leads indicated at 91 successively through the indicating lamps, as the contact element 90 moves in connection with a fixed contact 92 and into contact with additional fixed contacts 93 provided for the separate lamp circuits.

Referring now to Fig. 2, the same preselection tuning system may be employed in a superheterodyne receiver adapted for multiple wave band signal reception. This is shown, by way of example, as a system for receiving signals in three differing wave bands, such as the standard broadcast band at present used and a medium and a short band wave, together with means for presetting the signal or broadcasting station selection automatical-

ly in one of the wave bands such as the standard broadcast band.

As is customary in multiple wave band receivers, a wave band selector switch is provided in connection with the inductance and capacity tuning elements of both the oscillator and the $r-f$ or first detector circuits.

In the present example, the wave band selector switch comprises two interconnected sections 90, 91 for the $r-f$ or signal input circuits and the oscillator circuits, respectively, the first being to provide switching connections with $r-f$ inductance units comprising coils 92, 93, 94 and 95 for the signal input or grid circuit 96 and signal input grid 97 of a combined first detector and oscillator tube 98.

The output circuit of this device indicated at 99, is connected through an intermediate frequency amplifier input transformer 100 with an intermediate frequency amplifier indicated at 101. The input grid 97 is shielded by a screen grid 102 from the oscillator anode electrode 103, oscillator grid 104 and the common cathode 105. The signal input or grid circuit 96 for the first detector is connected through a fixed contact 106, a movable contact element 107 and a second fixed contact 108 in the switch section 90, to the high potential terminal 109 of the coil system 93-94, as indicated by the lead 110. A tap 111 on the coil system is connected with a fixed contact 112 and through a movable contact element 113 and a fixed contact 114 is grounded to complete an antenna or signal input circuit 115 to ground through the winding 92, for which the secondary becomes the windings 93 and 94 in the grid circuit 96 of the detector 98.

In this position, the switch section 90 provides connections for tuning the receiving system automatically to preselected broadcasting stations or signal channels by means of a plurality of adjustable tuning capacitors 116 connected in parallel relation and selectively rendered effective across the signal input circuit 96 and the secondary inductances 93 and 94, through individual push button selector switches 117. These are connected in parallel to a control lead 118 and with a fixed contact 119 of the switch section 90.

The switch arrangement is such that, as the switch contact element 107 is moved to change connections, in the direction of the arrow on the drawings, the contact 119 is open circuited, thereby disconnecting the push button tuning elements 116-117 and replacing it with the main tuning variable capacitor and shunt trimmer capacitor indicated at 120 and 121, respectively. The last named connection is made to a fixed contact 122 which engages the movable contact 107 as soon as it disengages from the contact 119. It will be seen that, as the switch is moved one step in the direction of the arrow, the remaining connections are unchanged, whereby the tuning system may be operated continuously variable throughout the broadcast band by the variable tuning capacitor 120.

Successive operations of the switch 90 in the direction of the arrow serve to render effective in circuit as tunable secondary windings, the coils 94 and 95 for the intermediate and short wave bands, and as this does not concern the present invention, no further description thereof is believed to be necessary.

Conjointly operable with the switch section 90, the switch section 91 of the range selector switch controls the oscillator circuits in a similar manner, serving to disconnect the oscillator 75

grid circuit, indicated at 125, from the connection or control lead indicated at 126, for a bank of parallel tuning inductances 127 and individual selector switches 128 therefor. When the switch 91 is moved from the position shown to the next position, for manual or variable tuning through the broadcast band, this grid connection is made through a fixed contact in the switch section 91, as indicated at 129, a movable contact element 130 and a fixed contact 131.

When the switch 91 is moved for manual tuning in the broadcast and the successive wave bands, the contact 131 is broken with the movable contact element 130 and is established between the contact element 130 and a fixed contact 132 for the main variable tuning capacitor for the oscillator as indicated at 133. This is arranged for uni-control operation with the tuning capacitor 120. Successive positions of the switch section 91 serves to render the oscillator effective for tuning in the medium and short wave bands and, since this does not concern the present invention, further description is believed to be unnecessary.

It should be noted that the oscillator anode circuit indicated at 134 is connected through a series of feedback windings 135, 136 and 137 and that the winding 137 is coupled to an inductance winding 138 which is connected with the contact 131 and the lead 126 for the preselection tuning system whereby feedback for preselection in any of the several channels arranged to be selected is provided by the single coil 138 at all times through feedback from the coil 137. This arrangement eliminates the necessity for switching in separate feedback windings as in the preceding embodiment of the invention shown in Fig. 1. In this arrangement, the inductance elements 127 are connected in parallel with the winding 138 in the oscillator grid circuit as the various switches 128 are closed for preselection tuning.

The feedback winding 137 is also coupled with a second winding 139 for the grid circuit of the oscillator, and the latter is effected as the oscillator inductance in the broadcast band when variably tuned by the capacitor 133, the connection with the movable contact element 130 being effected through a fixed contact 140 for the inductance winding 139.

The details of the oscillator circuit per se, as shown in Fig. 2, do not form part of this invention and are shown, described and claimed in a copending application assigned to the same assignee as this application.

It will be seen that in the $r-f$ or detector section of the switch, the contact 122 is provided for the variable tuning capacitor section 120, and a corresponding contact 132 is provided in the oscillator section 91 for the oscillator variable tuning capacitor section 133. Also, in the $r-f$ or first detector switching section 90, the contact 119 is provided for the manual preselection or control circuit 118 and a similar contact 131 is provided in the oscillator section 91 for the manual tuning circuit 126. Since the tuning of the $r-f$ or first detector circuit is provided by the adjustable capacitors 116, no change in the inductance switching is made for the variable tuning by the capacitor 120. The switching change includes merely disconnecting the circuit 118 for the preselection system and connecting the variable tuning capacitor 120 with the contact element 107.

However, since the tuning of the oscillator is by means of adjustable inductances, the switch-

ing change also involves disconnecting the oscillator grid inductance 138 and replacing it in circuit by the tuning inductance element 139, in addition to disconnecting the preselection circuit 126 and making the variable tuning connection at the contact 132.

In each of the wave band switch sections, a movable grid circuit contact element is arranged to select not only connections for the various wave band inductances, but also to select for the grid circuit either connection with the preselection tuning circuit or the manually variable tuning circuit, thereby simplifying the switch operations and the switch construction.

It will be seen that all of the tuning elements 126 and 116 are parallel connected to ground or chassis on one side, and through the selector switches 128 and 117 are connected to single control circuits. The switches for each channel are interconnected, as indicated by the dotted line connection 141, so that the inductance change in the oscillator circuit and the capacity change in the $r-f$ circuit for each selected channel may be made simultaneously and instantly to change from one channel or broadcasting station to another. The mechanical connection between the operating portions of the switch sections 90 and 91 is diagrammatically represented by the dotted connection 142.

Since the preselection tuning elements involve a common ground return connection and only two circuit lead connections 126 and 118, the parallel tuning elements may be placed in convenient positions on or near a receiver chassis, with the adjustable tuning elements grouped for facilitating operation and preselection adjustment. Since the two control circuits contain differing types of circuit tuning elements, namely, capacity adjusting elements for one circuit and inductance adjusting elements in the other circuit, the normal spacing when mounted being such as to render capacity coupling effects negligible, undesired effects from stray coupling are substantially eliminated. The preselection circuits, therefore, include a group of parallel connected circuit tuning elements for the signal selecting or detector circuit, all of which elements have electrical characteristics wholly unadapted for coupling with the plurality of circuit tuning elements for the oscillator which have differing electrical characteristics, whereby they may be related closely in a receiver chassis or tuning unit without shielding or additional complication and cost.

We claim as our invention:

1. In a radio signalling system, the combination with two tunable signal circuits, of means for tuning one of said circuits to a series of preselected frequencies comprising adjustable tuning capacitors and selector switch elements and a single control circuit for connecting said capacitors with said one tunable signal circuit, and means for tuning the other of said tunable signal circuits to a plurality of frequencies in predetermined relation to the tuning of said first named circuit, said last named means being associated with said tuning capacitors in a group with normal spacing to preclude capacity coupling effects therewith and comprising a series of adjustable tuning inductances whereby inductive coupling is prevented and selector switch elements conjointly operable with said first named selector switch elements and a single control circuit for selectively connecting said inductances in the other of said circuits.

2. In a superheterodyne radio receiving system, the combination with a tunable signal receiving circuit, of a plurality of adjustable capacitor elements for tuning said circuit to a plurality of predetermined frequencies, a tunable oscillator circuit, and means for tuning said oscillator circuit to a plurality of predetermined frequencies comprising a plurality of adjustable inductance elements selectively connectable with said oscillator circuit and each comprising an inductance winding having a movable tuning core element associated therewith to vary the inductance of said winding, said tuning elements being grouped to spacing limits precluding stray capacity coupling effects between said tuning elements whereby unitary adjustment of said circuits is provided without stray inductive coupling between the circuits and tuning elements thereof.

3. In a superheterodyne radio receiving system having a tunable signal receiving circuit and a tunable oscillator circuit, adjustable capacity means for tuning the signal receiving circuit and adjustable inductance elements for tuning the oscillator circuit whereby said tuning means for the signal receiving and oscillator circuits may to the limit of element-to-element stray capacity coupling, be associated without stray inductive coupling, thereby to provide a unitary arrangement for tuning adjustment, selective switching means for connecting said tuning elements one in each circuit in pairs, thereby to cause said system to respond to signals at preselected frequencies, and means for indicating the condition of adjustment of the selective switching means.

4. In a superheterodyne radio receiving system, the combination with means for tuning said system in a plurality of differing wave bands and including a tunable signal receiving circuit, a tunable oscillator circuit and wave band change switch means for said circuits, of a plurality of adjustable capacitor elements for tuning the signal receiving circuit and a plurality of adjustable inductance elements for tuning the oscillator circuit, a pair of tuning control circuits, means in said wave band change switch means providing a connection with the signal receiving circuit and said capacitor elements in parallel through one of said control circuits, and a connection with the oscillator circuit and said inductance elements in parallel through the other control circuit, a selector switch element in circuit with each of said tuning elements, and means for operating said switch elements in pairs whereby the signal receiving and oscillator circuits

are simultaneously tunable to receive signals in a plurality of differing signal channels in one wave band.

5. In a superheterodyne radio receiving system, the combination with a tunable signal receiving circuit having a high signal potential circuit lead and a grounded low signal potential circuit lead, a tuning inductance connected between said leads, an oscillator circuit having a high signal potential lead and a grounded low signal potential lead, a tuning inductance connected between said leads, a predetermined number of tuning capacitors each having an adjustable grounded electrode, a tuning control lead connected with the high signal potential lead of the signal input circuit, selector switch means for connecting each of said capacitors selectively with said tuning control lead, a plurality of tuning inductance elements corresponding in number to the number of said capacitors each comprising a winding grounded at one end and having an opposite terminal end, a grounded movable core element for each of said windings for adjusting the tuning thereof, a second tuning control lead connected with the high signal potential lead of said oscillator circuit, and selector switch means conjointly operable with said first named selector switch means for connecting each of said terminal ends of said windings selectively with said second tuning control lead whereby said tuning capacitors and inductance elements together with said selector switch means may be provided as a unit and connected with said receiving system through said tuning control leads and ground.

6. In a preselection tuning system for a superheterodyne receiver, a plurality of adjustable tuning capacitors for a signal input circuit of said receiver, a plurality of adjustable tuning inductances for the oscillator circuit of said receiver of the type comprising a winding having a movable core tuning element, said tuning capacitors and tuning inductances being arranged in spaced relation to each other for unitary tuning adjustment in one location in the receiver, and said tuning reactances being spaced and arranged in a group to have substantially no capacity coupling reaction one upon the other in the respective circuits whereby shielding for said tuning elements is eliminated without introducing stray inductive coupling therethrough between said signal input circuit and said oscillator circuit.

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