

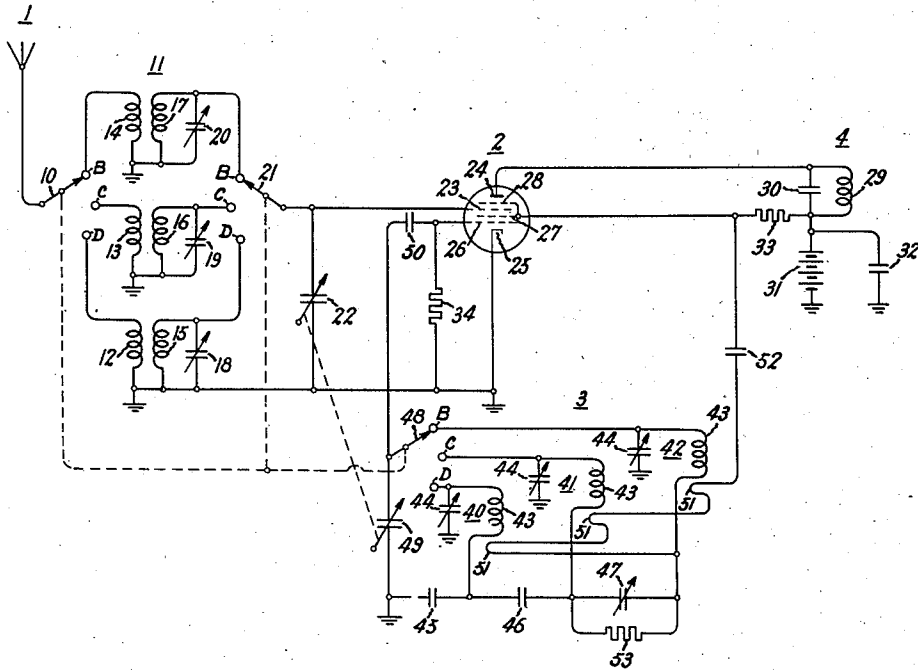
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MULTIBAND RECEIVER CIRCUIT

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MULTIBAND RECEIVER CIRCUIT

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My invention relates to multi-band oscillator circuits and in particular to such circuits as are used in multi-band radio receivers. It is an object of my invention to provide an improved oscillator circuit for such a receiver.

In multi-band receivers it is customary to employ transformers in the antenna and oscillator circuits, the number of such transformers employed in each circuit being equal to the number of frequency bands through which the receiver is designed to operate. Switching means is employed to transfer the radio frequency and oscillator circuits from one band to another. For receivers designed to operate over several or more bands, such switching means requires a large number of contact points with resultant large size and cost and complexity of the required mechanism. When a push-button type of switch is employed for this purpose, the difficulty of obtaining the required number of contact points is especially great and tends to influence against the use of this otherwise desirable type of switch. Accordingly, it is one of the objects of my invention to provide an improved multi-range oscillator circuit in which the number of switching points is reduced to a minimum.

Another object of my invention is to provide a multi-band oscillator for a super-heterodyne receiver in which shifting between frequency bands is effected by the switching of a single circuit thereof.

A further object of my invention is to provide an improved multi-range oscillator circuit in which the padder condensers of the component circuits are connected in series to effect certain improvements in the operating characteristics of the oscillator.

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 the single figure illustrates diagrammatically portions of a multi-range radio receiver circuit embodying my invention.

In the receiver circuit shown in the drawing, signal modulated carrier waves received on the antenna 1 are supplied to the converter 2 where they are mixed with oscillations from the local oscillator circuit 3 to produce, in the output circuit 4 of the converter 2, oscillations of an intermediate frequency. The voltages in the output circuit 4 may be amplified in subsequent

stages of intermediate frequency amplification, detected in a second detector circuit to reproduce the modulating signals, and ultimately supplied to a utilization device. These latter stages of the receiver circuit may be of any type well known in the art and, therefore, are not shown in the drawing.

The radio frequency voltages appearing on the antenna 1 are supplied by means of switch 10 to the desired primary winding of the different input transformers 14, 17; 13, 16, and 12, 15. As shown these transformers have respective primary windings 12, 13 and 14 and three associated secondary windings 15, 16 and 17, respectively. Across the latter windings are connected the trimmer capacitors 18, 19, 20, to provide an adjustable minimum capacity for these circuits. The switch 21 provides a means for selectively connecting the tuning capacitor 22 to these secondary circuits so that, by adjustment of the capacitor 22, each of the secondary circuits may be tuned through a band of radio frequencies. While the output voltages of the selected secondary circuit may be amplified through stages of radio frequency amplification if desired, for the sake of simplicity they are shown as supplied directly to the control electrode 23 of the converter 2.

The converter 2 is of a well known type and comprises, in addition to the control electrode 23, an anode 24, a cathode 25, an additional control electrode 26 and screen electrodes 27 and 28. The screen electrodes 27 and 28 are connected together to act as an anode for the oscillator portion of the converter 2 producing the heterodyne frequency to be combined with the radio frequency signals supplied to the control electrode 23. The heterodyne oscillations and the radio frequency signals are combined in the converter to provide, in the circuit of the anode 24 of the converter, currents of the desired intermediate frequency. These currents in turn are supplied to the output circuit 4, comprising the primary winding 29 and the capacitor 30, tuned to the intermediate frequency, the capacitor 32 being provided to by-pass the radio frequency and oscillator currents to ground. Operating potential for the anode 24 is provided from any suitable source shown, for example, as the battery 31, and operating potential for the screen electrodes 27 and 28 may also be obtained from the same source, the resistor 33 being provided to obtain the proper screen voltage.

The oscillator circuit 3 comprises a plurality of tuned input circuits 40—42, the number of

tuned circuits being equal to the number of bands of the receiver and the number of primary windings 12—14. Each of the circuits 40—42 comprises an inductance or secondary winding 43 and a trimmer capacitor 44, the latter providing an adjustable minimum value of capacitance for the particular band. Connected in series between each of the circuits 40—42 and ground is at least one of the padder condensers 45—47 which provide, in a manner well known in the art, a total effective padding capacity in the ground return of each of the circuits 40—42 for restricting the tuning ranges of the oscillator bands and for making the oscillator circuits track with the radio frequency circuits, that is, maintain a constant difference in frequency between these circuits over their bands. The capacitors 45—47 are likewise connected in series with each other for other reasons to be explained later. The terminals of the circuits 40—42 remote from the point of connection with the padder condensers are connected to contacts B, C, D, of switch 48 and the tuning capacitor 49, having a movable tuning element, is provided between the movable contact of switch 48 and ground to tune the circuits 40—42 through the range of frequencies in each particular band of the receiver.

Preferably, the switches 18, 21 and 48 are mechanically interlinked, as in a push-button type of switch, for simultaneous operation. Also, the circuit 40, connected to contact D of switch 48, is tuned to the shortest oscillator frequency wave band of the receiver, the circuit 41 to the intermediate or middle wave band, and the circuit 42 to the longest wave band. Similarly, the radio frequency transformer comprising primary winding 12 and secondary winding 15, connected to contacts D of switches 21 and 18, respectively, is tuned to the shortest radio frequency wave band of the receiver, and the transformers having primaries 13 and 14 are tuned to the middle and longest wave bands, respectively. Also, capacitors 22 and 49 are arranged for unicontrol in the usual manner for simultaneous adjustment of the radio frequency and oscillator circuits through the frequency range of each particular band.

The portion of the oscillator circuit 3 thus far described is coupled by means of capacitor 50 to the control electrode 26 so that the voltages in this input portion of the oscillator circuit are impressed between the control electrode 26 and the cathode 25, resistor 34 serving as a grid leak resistor for the oscillator.

Closely coupled to each of the inductances or secondary windings 43 is a coupling coil or primary winding 51. In accordance with my invention, these coils are all connected in series with each other and with the padding capacitors 45—47 and, coupled by means of capacitor 52 to the anode 27 of the oscillator, comprise an output circuit for the oscillator connected between the anode 27 and the cathode 25. Preferably, the coupling coils 51 have very little inductance and may be a single turn of wire. Likewise, they are wound as closely as possible against the lower end of the coils 43 to provide maximum coupling therewith. In this manner the total inductance of the coils 51 in series is maintained sufficiently low that the inter-electrode capacity between the cathode 25 and the anode 27 resonates with this inductance at a frequency substantially greater than the highest frequency in the band of the circuit 40 and the occurrence of any sharp peaks of voltage as the oscillator is tuned over the frequency bands is avoided.

It is noted in the above described circuit that the oscillator anode 27 is connected to ground through the three padding capacitors 45—47 so that the maximum possible common capacity coupling between input and output circuits occurs on each band of the oscillator through these padding condensers which are common to the input and output circuits of the oscillator. Thus, as the inductive coupling between the primary and secondary circuits of the oscillator decreases in the intermediate and longer wave bands because of the decreased inductive coupling of the low inductance coils 51 at these lower frequencies, the padder capacitor coupling between the circuits increases. The effective padding capacity for each band is, of course, the effective capacity between the lower terminal of the coil 43 of that particular input circuit and ground, which capacity thus consists of one or more of the padding capacitors 45—47. This capacity acts as a coupling between the output and input circuits and the capacitive reactance thereof increases as the reactance of the inductive coupling decreases at the lower frequencies, since two or more of the padder capacitors are connected in series to provide a smaller capacity for the coupling at these lower frequencies.

It is noted that the longer wave band circuits 41 and 42, which require progressively smaller padding capacity than the preceding shorter wave band circuits 40 and 41 respectively, are so connected between the switch 48 and ground as to include automatically a progressively smaller capacity, since each circuit progressively connects one or more of the capacitors 45—47 in series with the effective padding capacity of the preceding shorter wave band circuit.

The common capacity coupling may be so large on the longest wave band that it may be necessary to provide the resistor 53, connected across the capacitor 47, to reduce the amount of coupling and to prevent the local oscillations from reaching too great an intensity in the lower frequency end of this receiver band. In this manner the padder capacitor coupling is effective to reduce to as small an amount as possible the inductive coupling required between the output and input circuits of the oscillator so that the total inductance of the three coupling loops 51 may be kept small enough that it resonates with the capacity between anode 27 and cathode 25 at a frequency which is higher than the highest frequency in the band of circuit 40.

The capacitors 45—47, moreover, are proportioned to produce alignment of the local oscillator circuit 3 with the tuned radio frequency input circuits during variation of the unicontrol condensers 22 and 49 in a manner well known in the art.

It is thus seen that my invention provides a multi-range oscillator circuit having but two terminals in which the amount of oscillator switching is reduced to a minimum and in which the oscillator is switched between bands by merely connecting the oscillator grid 26 to the proper inductance 43. The common capacity coupling, or padder condenser coupling, is automatically varied merely by switching the high potential end of the oscillator tuning coils so that the full effective padder capacity for each coil is automatically connected to provide full padder coupling. All this is effected without changing the connections of any part of the output circuit of the padder condensers, or of the lower terminals of the tuning coils 43 so that the necessary switching of

oscillator output circuits commonly required is completely eliminated. This allows the use of a simpler band switch of whatever type it is desired to use. In particular, by the elimination of all switching in the output circuit of the oscillator, the use of a push-button type of switch is made possible without increasing the size, cost or complexity of operation of the normal type of push-button switch.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, and I contemplate by the appended claims to cover any such modifications as fall 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. The combination, in a local oscillator for a multi-band superheterodyne receiver, of an electron discharge device having an anode, a cathode, and a control electrode, a plurality of oscillatory circuits each including a stationary switch contact connected through an inductance and a capacitance to said cathode, and a single movable contact cooperating with said stationary contacts and connected to said control electrode and through a common tuning condenser having a movable tuning element to said cathode, said oscillatory circuits being tunable over different ranges by said tuning condenser, said capacitances being proportioned to produce desired rates of change of tuning through said range with variation of said movable element, said capacitances all being connected in series in the lower frequency of said circuits and between said anode and cathode to provide regeneration of said local oscillator.

2. In a superheterodyne radio receiver, the combination of a plurality of tuned radio frequency input circuits and means for tuning each of said circuits over a band of frequencies, each of said circuits having a common terminal, and an individual terminal, an oscillator adapted for operation over a plurality of wide bands of frequencies, and comprising an electron discharge device having an anode, a cathode and a control electrode, a plurality of oscillatory circuits each tunable over a different range of frequencies, each of said oscillatory circuits having a common terminal and an individual terminal, said common terminal being connected to said cathode, a permanent coupling between said anode and all of said oscillatory circuits, and switching means selectively to connect simultaneously said input circuits to said tuning means and said individual oscillatory circuit terminals to said control electrode.

3. The combination, in a multi-band superheterodyne receiver having a converter and a local electron discharge oscillator having an anode, a cathode and a control electrode, of a plurality of input circuits for said converter, a plurality of oscillatory circuits for said oscillator, a pair of uncontrolled condensers for tuning said circuits in alignment over desired bands of frequencies, and switching means selectively to connect said input circuits and local oscillator circuits to the corresponding one of said uncontrolled condensers, each of said oscillatory circuits including capacitance and inductance connected in series through said switch means in its

respective position across the respective uncontrolled condenser and between said control electrode and cathode, said capacitance of the lower frequency circuit being permanently connected in series with the capacitance of the higher frequency circuit and between said anode and cathode, whereby a single one of said capacitors is included in one of said circuits and two or more in series are included in each of the other circuits, said capacitors being proportioned to produce alignment of the local oscillator circuit with the input circuit during variation of said uncontrolled condensers.

4. The combination, in a radio receiver, of a converter having input electrodes, a local electron discharge oscillator having input and output electrodes, a pair of uncontrolled condensers each connected between a respective pair of said input electrodes, a plurality of tuned input circuits, a plurality of local oscillator circuits, and switch means selectively to connect said input circuits to said converter input electrodes and local oscillator circuits to the oscillator input electrodes for tuning in alignment over respective frequency ranges by said uncontrolled condensers, whereby said receiver is tunable over different frequency bands corresponding to different positions of said switch means, said switch means having a plurality of stationary contacts, each of said local oscillator circuits including an inductance and capacitance connected in series between one of said electrodes and a respective stationary contact of said switch means, said switch means including a contact connected to the other of said input electrodes and movable over said stationary contacts, said capacitances of all of said circuits being in series in that one of said circuits operating at the lower frequencies and in series between said output electrodes to couple said input and output electrodes.

5. The combination, in a radio receiver, of a converter having input electrodes, a local electron discharge oscillator having input and output electrodes, a pair of uncontrolled condensers each connected between a respective pair of said input electrodes, a plurality of tuned input circuits, a plurality of local oscillator circuits, switch means selectively to connect said input circuits to said converter input electrodes and local oscillator circuits to the oscillator input electrodes, whereby said receiver is tunable over different frequency bands corresponding to different positions of said switch means by said uncontrolled condensers, each of said local oscillator circuits including an inductance and capacitance connected in series between one of said electrodes and a respective stationary contact of said switch means, said switch means including a contact connected to the other of said input electrodes and movable over said stationary contacts, said capacitances of all of said circuits being in series in that one of said circuits operating at the lower frequencies and in series between said output electrodes to couple said input and output electrodes, and an inductance permanently in circuit with said capacitances and said output electrodes and coupled to each of said inductances, said last mentioned inductance resonating with said capacitances in series with the capacity of said output electrodes at a frequency higher than any frequency at which said local oscillator operates.

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