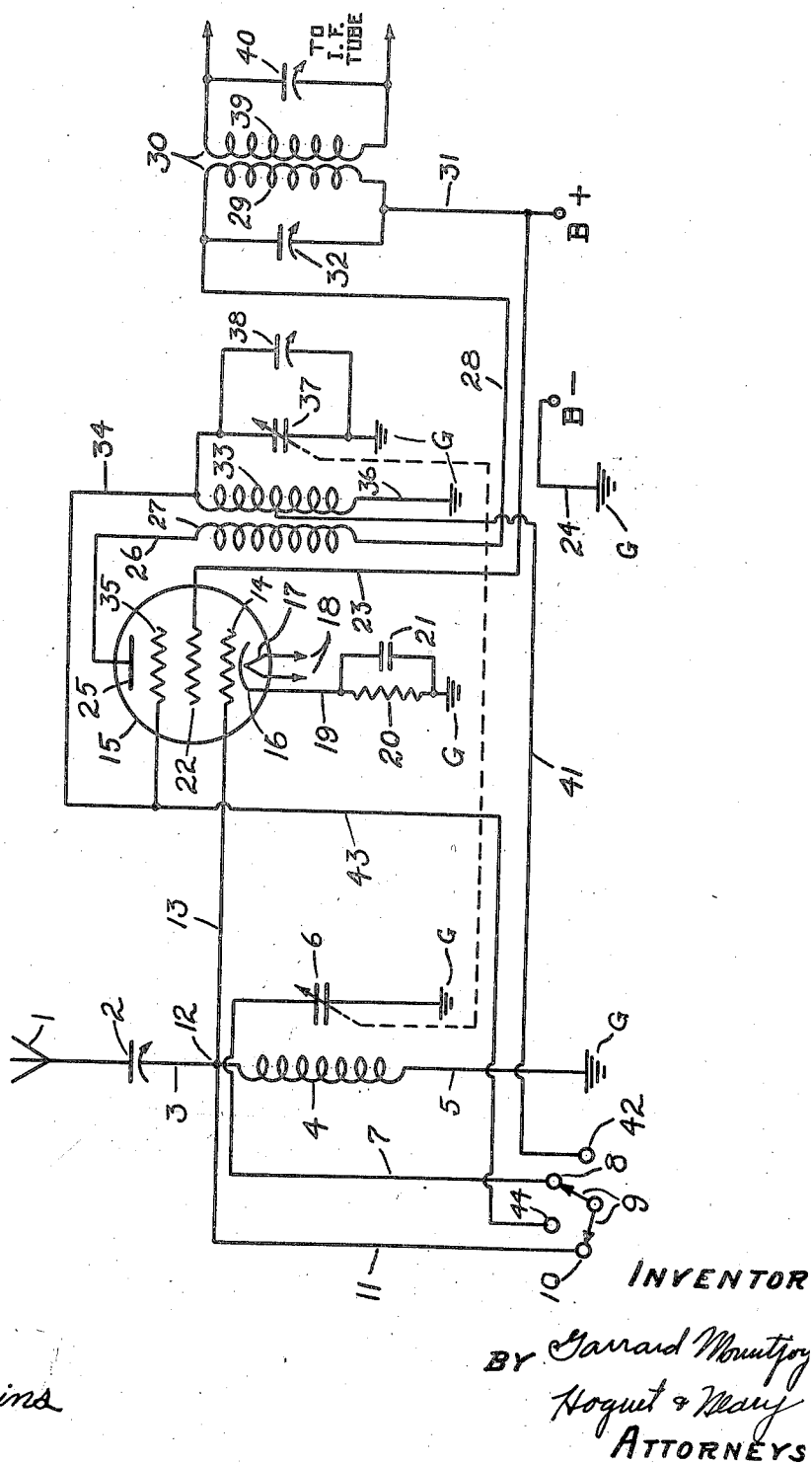


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MULTIBAND RADIO RECEIVER
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MULTIBAND RADIO RECEIVER

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This invention relates to a multi-band radio receiver, and more particularly, but not exclusively, to receivers of the superheterodyne type, in which a single tube functions both as oscillator and first detector.

Radio receiving set manufacturers, in an endeavor to meet the public demand for an inexpensive receiver, have been forced to abandon many refinements now known in the art which have made high quality radio reception a reality. The introduction of multi-band reception has placed an additional burden on the producers of the inexpensive receiver, and formerly, this added feature was possible only on higher priced receivers. The advent of the superheterodyne receiver, however, has materially aided the manufacturer in meeting this new demand. I have discovered that a simple but highly efficient selector circuit for a superheterodyne receiver can be constructed to accommodate both the broadcast range from 550 to 1500 kilocycles, and a short wave band from 1500 to 2700 kilocycles that requires, in addition to the regular broadcast band receiver, only a double-throw switch and several connecting leads.

It is an object of this invention to provide a simple and effective means for extending the frequency range of a broadcast superheterodyne receiver to include the reception of signals within a short wave or high frequency band.

Other objects and advantages relate to particular circuit arrangements used in carrying out my invention, and will appear more fully in the following description, taken in connection with the accompanying drawing, in which the single figure shows the circuit diagram of a radio receiver embodying the invention.

The use of the terms "broadcast band" and "high frequency" or "low wavelength band" in the specification and claims are intended to define a reception band approximately from 550 to 1500 kilocycles and approximately from 1500 to 2700 kilocycles respectively.

Referring to the drawing, the incoming signal may be received by antenna 1 of any well known type. Antenna 1 is connected to a variable equalizing condenser 2 which, in turn, is connected to one end of coil 4. The other end of coil 4 is connected by conductor 5 to ground G. Coil 4 may be tuned by a variable condenser 6 having the rotatable elements connected to ground G, and the stationary elements connected by means of wire 7 to contact 8 of switch 9.

Contact 10 of switch 9 is connected by wire 11 to the high potential side of coil 4 at 12. The

purpose of switch 9 will be more fully described later.

Coil 4 is connected by wire 13 to the control grid 14 of tube 15. In this instance, tube 15 is shown as a multi-purpose tube of the screen grid type adapted to function both as a first detector and oscillator.

Cathode 16 of tube 15 may be of the indirectly heated type having a heater 17 energized from a suitable source of electrical potential through conductors 18. A connection is made from cathode 16 by means of conductor 19 through grid bias resistance 20 to ground G. Condenser 21 serves as a radio frequency by-pass around resistance 20, which function is well understood.

Screen grid 22 of tube 15 may be connected by wire 23 to the positive terminal of a suitable source of direct current potential indicated at B+. The negative terminal of this source of potential is indicated at B-, which, in turn, may be connected to ground G by wire 24.

Plate electrode 25 of tube 15 is connected by wire 26 to one end of plate oscillator coil 27. The other end of coil 27 is connected by wire 28 to one end of primary 29 of an intermediate frequency transformer 30. The other end of primary 29 is connected by wire 31 to the terminal B+ of the direct current potential source.

Primary 29 may be tuned to a fixed intermediate frequency by adjustable condenser 32 connected in parallel therewith. The secondary 33 of transformer 30 is also tuned to the same fixed intermediate frequency, as primary 29, in this instance, by an adjustable condenser 40. The output terminals of secondary 33 may be connected to succeeding circuits, not shown, consisting usually of an intermediate frequency amplifier tube, second detector, audio frequency amplifier, and a suitable loud speaker, the functions of which are well known and need not be further described.

Plate oscillator coil 27 is magnetically coupled to grid oscillator coil 33, one end of which is connected by wire 34 to suppressor grid 35 of tube 15. The other end of coil 33 is connected to ground G by wire 36. Coil 33 is tuned by means of a variable condenser 37 in which the rotor plates are preferably connected to ground G and the stator plates to the high potential side of coil 33. In order to provide for uni-control of condenser 6 and condenser 37, the latter is shunted with a trimmer condenser 38.

Thus it is seen that a tuned oscillating circuit is provided between the plate circuit connected to plate electrode 25, and the grid circuit connected to suppressor grid 35. Condenser 37 is

adapted to tune this oscillating circuit to a frequency differing from the incoming signal by a desired intermediate frequency, and preferably, above the frequency of the incoming signal desired to be received.

Although a multi-purpose tube 15 is shown having a grid 35 for the oscillating circuit apart from the control grid 14, it is apparent that separate detector and oscillator tubes could be employed without departing from the spirit of the invention.

In order to increase the frequency range of oscillator coil 33, a tap is taken intermediate its ends, and a connection made thereto by wire 41 to switch contact 42. The high potential end of coil 33 is also connected through wire 34 and wire 43 to switch contact 44.

Thus it is seen, if switch arms 9 are simultaneously moved to bridge contacts 42 and 44, the upper portion of coil 33 will be short-circuited. The tap on coil 33 is so positioned that the remaining inductance, after short-circuiting the upper portion, is sufficient to tune the oscillator with the available capacity of condenser 37 over the desired high frequency band.

In operation, if it is desired to receive signals within the broadcast band covering frequencies from 550 to 1500 kilocycles, switch 9 is placed in the position as shown in the drawing. Condenser 6 will then be connected in parallel with coil 4 so as to tune the input circuit of tube 15 to the desired frequency. The incoming signal thus selected, is then impressed upon control grid 14, which modulates the electron current between plate 25 and cathode 16 so as to produce an amplified current of the same frequency as the selected signal. However, plate 25 is coupled by means of coil 27 to an oscillator coil 33 tuned to oscillate at a frequency above the selected radio frequency. Thus, there results, in a manner well known in the art, a current in coil 27 having a frequency equal to the difference of the signal frequency and the oscillator frequency called the intermediate frequency, which is delivered to transformer 30 by conductor 28, and returned through the plate potential source to ground. This intermediate frequency signal may be amplified, and finally reproduced as sound in a loud speaker in a well known manner.

If it is now desired to receive signals of higher frequency or within a short wave band, switch 9 is thrown to the right so as to bridge contacts 42 and 44. In this position, tuning condenser 6 will be disconnected from coil 4 and, at the same time, the upper portion of oscillator coil 33 will be short-circuited. The input circuit of tube 15 now comprises only antenna 1, antenna equalizing condenser 2 and coil 4.

I have found that this circuit has a resonance in the high frequency band between 1500 and 2700 kilocycles at which the circuit exhibits an antenna gain of 30 units, which gradually falls off to unity on either side of the resonant point, but throughout a spectrum of 2000 kilocycles, the gain varies from the maximum of 30 to unity transfer of energy. If exact resonance is desired for all frequencies within this band, it can be obtained by adjusting antenna equalizing condenser 2. However, commercially, it has been found that receivers embodying this circuit work satisfactorily with no separate adjustment of condenser 2 for each station, as the antenna gain is inherently sufficient to give good results. It is, of course, appreciated that better pre-selection accompanied by a higher image ratio is obtained

by utilizing the adjustable feature of condenser 2. The high frequency signal thus selected is impressed upon grid 14 of tube 15 in the same manner previously described for the reception of broadcast frequencies.

The fact that the upper portion of oscillator coil 33 has been short-circuited by closing contacts 42 and 44 of switch 9, shifts the oscillator frequency band to a higher value commensurate with the frequency of the incoming signal so as to produce the desired intermediate frequency. Tuning the oscillator in order to produce the required intermediate frequency is accomplished by variable condenser 37. Intermediate frequency amplification, detection and audio frequency amplification may, of course, be accomplished for short wave reception in a manner previously described.

In reverting to reception of broadcast frequencies, switch 9 is thrown to the left, thereby removing the short circuit connection through switch contacts 42 and 44 from the upper portion of oscillator coil 33, and again connecting tuning condenser 6 in parallel with coil 4 through switch contacts 8 and 10. If antenna condenser 2 has been used to improve pre-selection during high frequency reception, it will be necessary to make adjustments as follows: Tuning condenser 6 and 37 are set to receive any station within the broadcast frequency band; condenser 2 is then adjusted to give maximum response of the receiver to the incoming signal; when this has been accomplished, the antenna circuit is equalized, and no further adjustment of condenser 2 is required for other stations in the broadcast frequency band.

Thus it is seen that it is possible to extend the receiving range of a superheterodyne type of receiver to cover a short wave band by merely providing a single switch that disconnects the input tuning condenser and short-circuits a portion of the oscillator coil.

Although I have shown a specific circuit arrangement for accomplishing the desired result, it is to be understood that the same was for the purpose of illustration, and that many changes and modifications may be made without departing from the spirit and scope of the appended claims.

I claim:

1. In radio receiving sets, a vacuum tube, an input circuit comprising a coil connected in the grid-cathode circuit of said tube and an antenna coupled to said coil, said circuit being resonant with a given frequency band, a variable condenser normally connected in parallel with said coil for tuning it over a given frequency band, means for disconnecting said condenser from said coil, and means in circuit with the antenna for tuning the grid-cathode circuit with the antenna over a band of frequencies higher than said given band when said variable condenser is disconnected from said coil.

2. In radio receiving sets, a vacuum tube, an input circuit for said tube comprising an antenna connected to the grid and a coil connected in the grid-cathode circuit, said input circuit being resonant within a high frequency band, a variable condenser normally connected in parallel with said coil for tuning said input circuit over a band of frequencies lower than said first named band, means for disconnecting said condenser from said input circuit, and means for tuning said input

circuit over said high frequency band when said variable condenser is disconnected therefrom.

3. In radio receiving sets, a vacuum tube, an input circuit for said tube comprising an antenna 5 connected to the grid and a coil connected in the grid-cathode circuit, said input circuit being resonant within a high frequency band, a variable condenser normally connected in parallel with said coil for tuning said input circuit over a band 10 of frequencies lower than said first named band, means for disconnecting said condenser from said input circuit, and a second variable condenser in circuit with said antenna and said coil for tuning the input circuit over said high frequency band 15 when said first named variable condenser is disconnected therefrom.

4. In superheterodyne receiving sets, a vacuum tube, signal receiving means therefor comprising a coil, a variable condenser normally connected 20 in parallel with said coil for tuning it over a given frequency band, an oscillator circuit for said tube including a second coil, a second variable condenser for tuning said second coil over a band differing in frequency from the signal by a desired 25 intermediate frequency, and switch means for simultaneously disconnecting said first-named condenser from the signal receiving means and for short-circuiting a portion of said second coil.

5. In superheterodyne receiving sets, a vacuum 30 tube, signal receiving means comprising an antenna, a coil and a variable condenser in series for tuning said means over a high frequency band, said coil being connected in the grid-cathode circuit of said tube, a second variable condenser 35 normally connected in parallel with said coil for tuning it over a lower frequency band, an oscillator circuit for said tube including a second coil, a third variable condenser for tuning said second coil over a band differing in frequency from the 40 signal by a desired intermediate frequency, and switching means for simultaneously disconnecting

said second named condenser from said first coil and for short-circuiting a portion of said second coil.

6. In a multi-band superheterodyne receiving set, a vacuum tube, signal receiving means com- 5 prising an antenna, a coil and a variable condenser in series for tuning said means over a high frequency band, said coil being connected in the grid cathode circuit of said tube, a second variable condenser normally connected in parallel 10 with said coil for tuning it over a lower band of frequencies, an output circuit for said tube including a second coil, said second coil being connected to the plate of said tube, an oscillator circuit for said tube including a third coil magnetically coupled with said second coil, a third vari- 15 able condenser for tuning said third coil over a band differing in frequency by a desired intermediate frequency and switch means for simultaneously disconnecting said second condenser 20 from said first coil and for short-circuiting a portion of said third coil thereby rendering said receiver responsive to signals within said high frequency band.

7. In superheterodyne receiving sets, a vacuum 25 tube, signal receiving means therefor, said signal receiving means being normally resonant within a given frequency band, tuning means adapted to be connected in resonance producing relation with said signal receiving means for tuning the 30 latter over a band of lower frequencies, switching means for disconnecting said tuning means from said signal means to render the latter responsive over said given frequency band, an oscillator circuit for said tube, and means operable simul- 35 taneously with said switch means for adjusting the oscillator circuit to tune over different frequency bands, differing in frequency from each signal frequency band by a desired intermediate frequency.

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