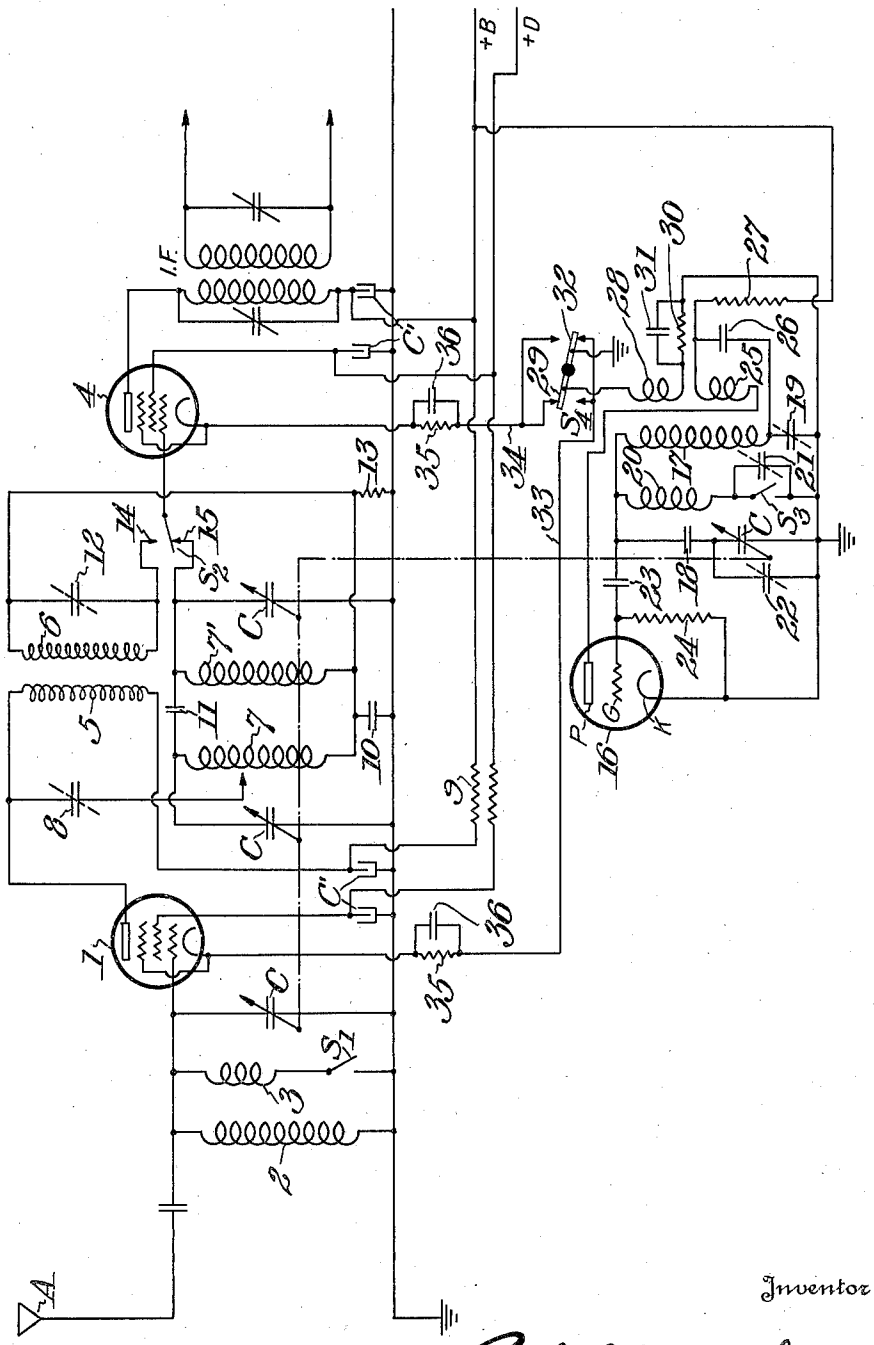
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RADIORECEIVER

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RADIO RECEIVER

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This invention relates to radio receivers and particularly to superheterodyne receivers of the multirange type.

It is well known that the design of any multirange receiver involves the satisfying of various conflicting requirements or, in general, the choice of a preferred compromise between the conflicting design requirements. The problem is particularly difficult when the rigid conditions are imposed that the receiver is to be of the superheterodyne type and that the same intermediate frequency is to be employed for all carrier wave ranges. High efficiency and satisfactory operation over a plurality of ranges may be attained by the use of "plug-in" inductances and/or tuning condensers, or by the use of vernier adjustments to correct for a faulty alinement of the several tuning elements but such arrangements are not advisable in radio receivers that are to be manufactured commercially for general distribution to the public. A receiver for general use should be of the single control type and should have selectivity and sensitivity characteristics in the broadcast band which are comparable with those of the usual single-range broadcast receivers. The performance in the other ranges, which are usually of higher frequency or "short wave" ranges may be less satisfactory than is possible with receivers designed to receive only the higher frequencies but the primary use of all receivers is on the broadcast band and it is therefore essential that good reception on that band must not be sacrificed in extending the operating range of a receiver to include other frequency ranges.

An object of the present invention is to provide an improved type of superheterodyne receiver for operation over a plurality of frequency ranges. An object is to provide a multirange superheterodyne receiver which has high selectivity in the lower frequency ranges and which has a high sensitivity in the higher frequency ranges. A further object is to provide a superheterodyne receiver including a fixed intermediate frequency amplifier and a dual-function stage preceding the intermediate frequency amplifier, the said stage operating as a tuned carrier wave amplifier during the reception of signals falling within one or more ranges of relatively low carrier frequencies and as a first detector stage during the reception of signals falling within higher frequency ranges. More specifically, an object of the invention is to provide a superheterodyne receiver including one or more inductances and associated switching systems for adapting the inductances to resonate with sections of a gang tuning condenser over different tuning ranges, a local oscillator including inductances and switches which adapt the oscillator to operate over the different tuning ranges, a pair of cascaded tubes, and a circuit network including switches for associating the tubes with the tuned circuits and the oscillator in such manner that the two tubes operate as a carrier wave amplifier and a first detector in the reception of low frequency signals and as a first detector and intermediate frequency amplifier in the reception of high frequency signals.

Further specific objects of the invention are to provide a novel form of multirange oscillator network which may be alined with multirange carrier circuits to produce a constant beat or intermediate frequency for all adjustments of the carrier wave and oscillator circuits.

These and other objects and advantages of the invention will be apparent from the accompanying drawing in which the single figure is a fragmentary circuit diagram of a multirange superheterodyne receiver embodying the invention.

The drawing illustrates only those parts of the receiver which are peculiar to the present invention and omits the details of the main intermediate frequency amplifier, the detector, the audio amplifier and the reproducer. The particular construction of these elements may conform to any appropriate or desired design and forms no part of the present invention.

As illustrated, the input system between the antenna A and the first tube 1 of the receiver includes the inductance 2 in parallel with the tuning condenser C which is preferably one section of a gang condenser. A high frequency inductance 3 in series with a switch S_1 is connected across the inductance 2 and, as is well known, the closing of the switch S_1 changes the tuning range of the input system to cover a higher band of carrier frequencies. The coupling system to the next tube 4 includes both an intermediate frequency and a lower range carrier frequency impedance in the output network of the tube 1, the intermediate frequency impedance being the primary winding 5 which has a secondary winding 6, and the carrier wave impedance being the inductance 7 which has a tapped connection to the plate of tube 1 by relatively fixed condenser 8. The inductance 7 is tunable over the low range carrier range by the shunt condenser C which may be and preferably is a section of a gang tuning condenser. The condenser 8 is ad-

justable to tune the primary winding 5 to the intermediate frequency, and the connection of condenser 8 to coil 7 is preferably adjustable. The low potential (carrier frequency) terminal of the inductance 5 is connected to an appropriate source of plate potential +B, through the isolating resistance 9 and is bypassed to the cathode of tube 1 for carrier frequencies by the condenser C'. The tuned circuit 7, C includes the large coupling capacity 10 for coupling to a similar tuned circuit 7', C and, preferably, an additional coupling capacity 11 is provided between the high potential terminals of these tuned circuits to improve the sensitivity versus frequency characteristic of these tuned circuits.

The secondary 6 of the intermediate frequency coupling system is tuned by the adjustable but relatively fixed condenser 12, and the low potential terminals of the inductances 6 and 7' are grounded through the high resistance 13 which is in parallel with the coupling condenser 10. The high potential terminals of the intermediate frequency and carrier wave frequency coupling circuits are connected, respectively, to the fixed contacts 14, 15 of the switch contact S_2 which is connected to the control grid of the tube 4. The intermediate frequency circuits I. F. into which tube 4 works may be of the usual or desired design.

The circuits associated with the local oscillator tube 16 are of appropriate design for operation over a plurality of frequency ranges and include a low frequency coil 17 in series with the gang tuning condenser section C and with the padding or lagging capacity which is provided by the relatively large fixed condenser 18 and the smaller adjustable condenser 19. A coil 20 of lower inductance than the coil 17 is in series with a small adjustable condenser 21, the condenser being shunted by a switch S_3 and these serially connected elements form a path in shunt with the elements C, 18 and the elements 17, 19. A small condenser 22 is shunted across the tuning condenser C for alining the high frequency tuning range of the oscillator with the carrier circuit. One common terminal of the three parallel paths of the oscillatory network is grounded and the other is connected to the grid G of tube 16 through the blocking condenser 23, the grid bias being obtained through the usual grid resistor 24.

With the switch S_3 open the oscillator may be alined for tuning over the low frequency range. The inductance of the coil 17 is somewhat less than that of the carrier circuit coils 2, 7 and 7' and adjustment of the condensers 19 and 21 permits a single control of the tuning circuits, by the gang condenser, to maintain a substantially constant intermediate frequency. With the switch S_3 closed for operation on the high frequency range, the required lower value of the oscillator tuning inductance is provided by the coils 17, 20 which are now effectively in parallel. The series padding or lagging capacity is now provided substantially entirely by the condenser 18 and, as previously noted, the condenser 22 is adjustable to aline the oscillator tuning with that of the higher carrier range to obtain the same constant intermediate frequency by the single control adjustment of the gang tuning condenser.

The plate feedback coupling is obtained through the tickler coil 25 and from the potential drop across the padding condenser 19 through the coupling condenser 26. The direct current feed to the plate P is through the resistor 27 which is connected between an appropriate source, indicated as +B, and the junction of coil 25 and condenser 26. The plate tickler coil 25 is coupled to both the coil 17 and the coil 20, the three coils being conveniently wound on the same form.

A coupling coil 28 is connected to one contact 29 of a switch S_4 and, through the bias resistor 30 and its shunting condenser 31, to ground. The other contact 32 of the switch is grounded and the cathode leads 33, 34 of the tubes 1 and 4, respectively, are so connected to the four contacts of the switch that one cathode circuit is returned directly to ground while the other is connected to ground through the coupling coil of the local oscillator. Each cathode lead includes a bias resistor 35 and bypass condenser 36, the resistors being of such magnitude as to furnish an automatic bias suitable for operation of the associated tube as an amplifier, and the additional bias necessary for operation of either tube as an efficient first detector is furnished by the potential drop across the resistor 30 in the coupling circuit.

As illustrated in the drawing, the several switches are adjusted for the reception of signals in the lower frequency band. The switches S_1 and S_3 are open to permit the simultaneous tuning of the input circuit of tube 1 and the oscillator circuit over their lower range, the switch S_2 couples the grid of tube 4 to the tuned carrier circuit 7', C and the switch S_4 is positioned to ground the cathode circuit of tube 1 and to introduce the local oscillator voltage into the cathode circuit of the tube 4. The tube 4 operates as the first detector and the three tuned carrier circuits preceding this tube provide adequate selectivity for the reception of signals in the broadcast range of from 550 to 1500 kilocycles. For operation over the higher range, the switches S_2 and S_4 are adjusted to their alternative positions, and the switches S_1 and S_3 are closed to adjust the inductances of the respective associated circuits for tuning over the higher frequency range.

For greater clearness of illustration, the several switches S_1, S_2, etc., are shown as separate elements adjacent the particular portions of the circuits which they control but it will be understood that a common operating member will be provided to control the several switches simultaneously.

The tube 1 now functions as the first detector since the local oscillator voltage is introduced into the cathode circuit of that tube while the cathode circuit of tube 4 is returned to ground. The single tuned circuit preceding the tube 1 provides adequate selectivity in the higher frequency range, and high sensitivity is obtained by the addition of one stage to the intermediate frequency amplifier.

It will be understood that the invention is not limited to the particular circuit arrangements herein illustrated and described as the novel method of altering the functions of certain tubes to obtain optimum transmission characteristics in different frequency ranges may be employed with tuned circuits of other design and, in particular, with tuned circuits which are adapted to be tuned over more than two frequency ranges. Additional tuning ranges may be provided in either or both of the two general circuit arrangements that are controlled by the adustment of the switch S_4.

I claim:

1. In a radio receiver adapted to tune continu-

ously over a plurality of frequency ranges, the combination with a tube, an input circuit for said tube, said circuit comprising a plurality of inductances and switch means cooperating with a condenser; adjustable to tune said circuit over a plurality of frequency ranges, and a second tube, of a coupling network between said tubes, said network including circuit elements comprising two independent and electrically parallel paths for transmitting high frequency currents of substantially different ranges, one of said paths consisting of relatively fixed circuit elements and the other path including a circuit tunable over one of the said frequency ranges, and switch means for alternatively rendering one transmission path operative and the other inoperative in accordance with the adjustment of said tuned input circuit for operation over a particular frequency range.

2. In a superheterodyne receiver, the combination with a plurality of cascaded circuits simultaneously tunable over a relatively low frequency range, means adjusting one of said circuits for tuning over a higher frequency range, a tube succeeding the multirange tunable circuit in the direction of transmission through the receiver, a second tube having an output circuit tuned to a fixed intermediate frequency, an intermediate frequency coupling circuit adapted to serve as a coupling between said tubes, an oscillator tunable simultaneously with said multirange tunable circuit to produce an oscillator voltage differing by the said fixed frequency from the resonant frequency of the multirange tunable circuit, and circuit elements including switch means for completing a transmission circuit including both tubes and all of said cascaded tunable circuits or alternatively for completing a second transmission circuit including said multirange tunable circuit and said intermediate frequency coupling circuit between said tubes, said switch means and circuit elements coupling said local oscillator to said second tube when the first transmission circuit is established and coupling said local oscillator to the first tube when the second transmission circuit is established.

3. In a superheterodyne radio receiver, the combination with a tube having an input circuit tunable over a plurality of carrier frequency ranges, of a second tube having an output circuit tuned to an intermediate frequency, and a local oscillator including a network tunable over a plurality of frequency ranges, of means for alternatively introducing the local oscillator voltage into a circuit of one or the other of said tubes, a coupling network between said tubes including circuit elements forming a pair of transmission paths for passing substantially different frequency ranges, and means for alternatively rendering one of said paths operative and the second path inoperative in accordance with selection of the tube upon which the local oscillator voltage is impressed.

4. A superheterodyne receiver of the multirange type comprising a pair of tubes serially arranged in the direction of transmission through the receiver, an input circuit for the first of said tubes and including means for tuning the same over a plurality of frequency ranges, an intermediate frequency output circuit for the second tube, a local oscillator tunable over a plurality of frequency ranges to produce the same constant intermediate frequency when the oscillator voltage is combined with the desired signal voltage of any of said ranges, a plurality of alternatively operable coupling circuits between said tubes, one of said coupling circuits being tuned to the same intermediate frequency as that of the output circuit of the second tube and another of said coupling circuits being tunable over one of the frequency ranges of the said input circuit, and means for introducing the oscillator voltage into the second tube and simultaneously coupling said tubes by a tunable coupling circuit, whereby the first tube operates as a carrier wave amplifier working into the second tube, or alternatively introducing the oscillator voltage into the first tube and coupling said tubes by said intermediate frequency coupling circuit, whereby the second tube operates as an intermediate frequency amplifier working out of said first tube.

5. In a superheterodyne receiver, the combination with a carrier frequency circuit and an oscillator network each tunable over a plurality of frequency ranges to produce the same constant intermediate frequency for all carrier frequency ranges, an oscillator tube connected to said oscillator network, a pair of tubes serially arranged in the line of signal transmission through the receiver, said carrier frequency circuit being the input circuit of the first tube, and an intermediate frequency circuit into which the second of said tubes works, of means including switch elements for impressing the oscillatory voltage developed by said oscillator network and tube alternatively upon either of the tubes of said pair, whereby either tube of said pair may be operated as the first detector of the receiver, and means alternatively adjustable to constitute a carrier frequency or an intermediate frequency transmission path between said pair of tubes as, respectively, the second or the first tube of said pair is operated as the first detector.

6. In a superheterodyne receiver, the combination with a first tube having an input circuit tunable over a plurality of carrier frequency ranges, an oscillator having a network tunable simultaneously with said input circuit and over a plurality of frequency ranges to exhibit a constant difference between the oscillator frequency and the resonant frequency of the input circuit, and a second tube having an output circuit tuned to a beat frequency resulting from the combining of the carrier and oscillator voltages, of a coupling network between said tubes and said oscillator; said network including a transmission path tuned to the said beat frequency and a transmission path tunable simultaneously with said input circuit over a lower range of frequency to which said input circuit is tunable, and switch means for introducing the oscillator output voltage into the second tube and coupling said tubes through said tunable transmission path or alternatively introducing the oscillator output voltage into said first tube and coupling said tubes through said beat frequency tranmission path.

7. In a superheterodyne receiver, a tube having an input circuit including tuning means and a switch for adjusting said circuit for operation over a plurality of frequency ranges, an output network for said tube including a circuit tuned to a fixed intermediate frequency and a circuit tunable simultaneously with said input circuit over the lower frequency range of said input circuit, a second tube, input circuit means for said second tube including a switch for alternatively coupling said tubes through either one of the circuits of said output network, an output circuit for said second tube tuned to the said intermediate frequency, an oscillator having a net-

work tunable over a plurality of frequency ranges, means for tuning said oscillator network simultaneously with the tuning of said input circuit to produce an oscillator voltage that may be combined with the desired carrier voltage to produce a beat frequency equal to the said intermediate frequency, and means for introducing the oscillator voltage into a circuit of the second tube when said input circuit is tuned over a lower frequency range and said tubes are coupled through said tunable circuit of the output network or alternatively for introducing the oscillator voltage into a circuit of said first tube when said input circuit is tuned over a higher frequency range and said tubes are coupled through the fixed intermediate frequency circuit of said output network.

8. A receiver as claimed in claim 7, wherein said means for alternatively introducing the oscillator voltage into a circuit of either tube includes means for adjusting the bias voltages on said tubes to alternative values for amplification or alternatively for detection.

9. In a multirange superheterodyne receiver, the combination with a circuit tunable over a low and a high frequency range by a section of a gang condenser, of an oscillator tube having an oscillatory network tunable over corresponding frequency ranges by another section of the gang condenser; said network including a fixed and an adjustable condenser in series with the said other gang condenser section and an inductance, and a path connected across said serially connected elements at the junction of the fixed condenser and the inductance and the junction of the said other condenser section and the adjustable condenser, said path including a second inductance in series with an adjustable condenser shunted by a shorting switch, said second inductance being of lower value than said first inductance, and an adjustable condenser shunted across the said other condenser section, the said junctions serving as the opposite terminals of the oscillatory network.

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