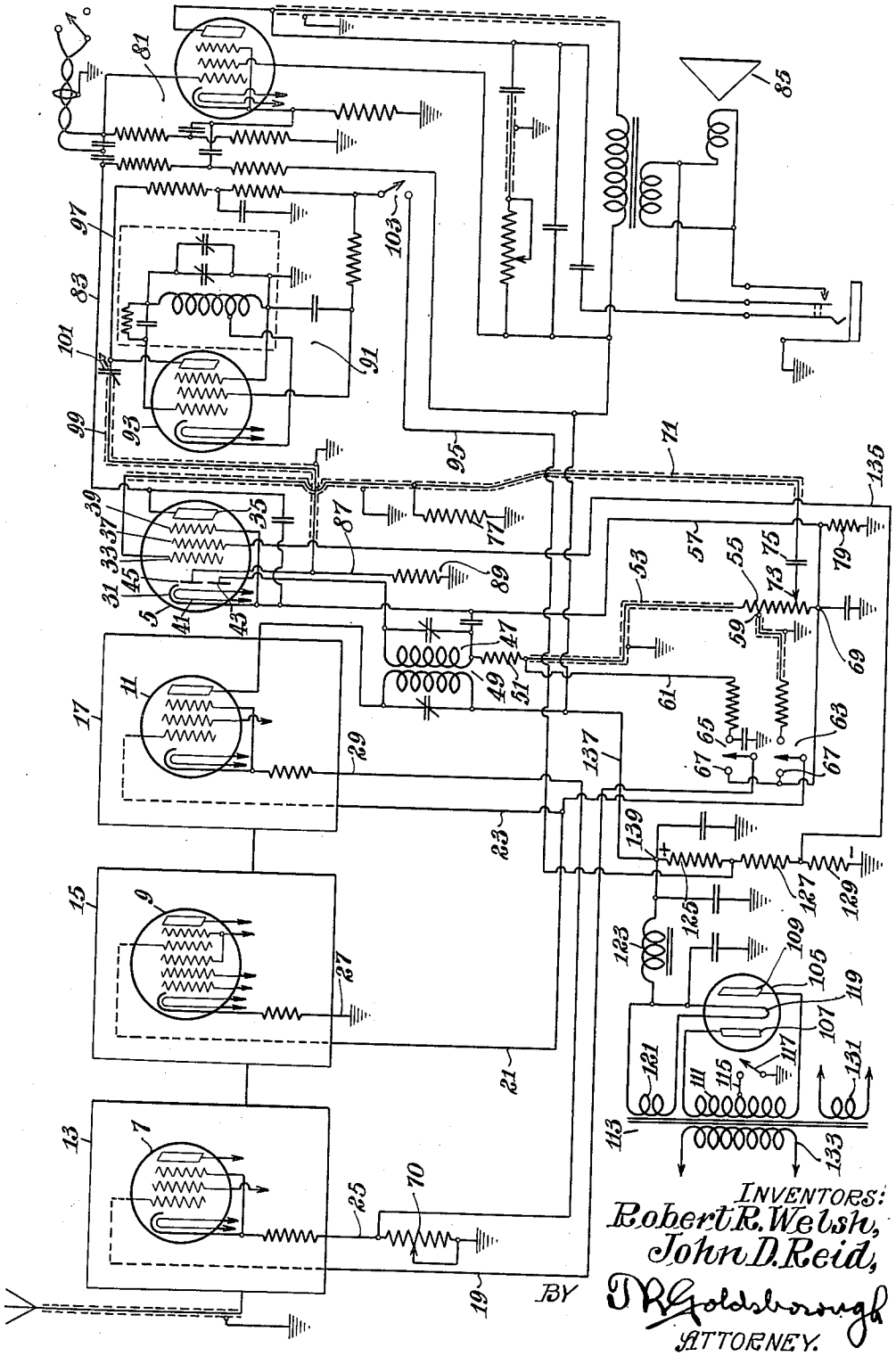
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DETECTOR OSCILLATOR COUPLING SYSTEM

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DETECTOR-OSCILLATOR COUPLING SYSTEM

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The present invention relates to detector-oscillator coupling systems for radio receiving apparatus and the like, and more particularly it relates to a system for coupling an oscillator or source of oscillations to a diode type of rectifier or detector in radio receiving apparatus and the like.

It is an object of the present invention to provide an improved system for coupling an oscillator or source of oscillations to a detector of the diode rectifier type.

It is also an object of the present invention to provide an improved detector-oscillator system for radio receiving apparatus and the like, wherein an oscillator may effectively be coupled to a diode type of rectifier or detector without rectification of the oscillations therefrom.

It is a still further object of the present invention to provide an improved oscillator coupling system for a diode type rectifier or detector in a radio receiver having an automatic volume control system connected with the diode rectifier, which prevents the oscillator from unduly operating the automatic volume control system in the absence of received signals.

The invention has particular application to radio receivers adapted for modulated and unmodulated continuous wave reception, and in the reception of unmodulated continuous wave signals has particular application to the second detector of a superheterodyne receiver to produce the desired beat note.

In providing a radio receiver for both modulated and unmodulated continuous wave signals, it is desirable that automatic volume control means be provided for modulated wave reception, such as broadcast signals, while the same may be rendered ineffective for slow speed continuous wave signals. It is desirable that the receiver be adapted for "stand-by" operation in association with a transmitter, for example, so that it may rapidly be put into and out of operation. With modern heater type cathodes this involves more than merely turning off and on the appartus.

It is, therefore, a still further object of the present invention to provide an improved radio receiver which is adapted for modulated and unmodulated continuous wave reception and which has the improved features above enumerated, including the improved coupling system for a beat frequency oscillator with the second detector, improved stand-by switching means, and improved automatic volume control selector means for unmodulated continuous wave operation.

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

In the drawing, the figure is a schematic circuit diagram of a superheterodyne receiver embodying the invention.

Referring to the drawing, 5 is a second detector of a superheterodyne receiver having the usual radio frequency amplifier tube 7, combined detector-oscillator tube 9, and intermediate frequency amplifier tube 11, said last named tubes being suitably coupled in any well known manner through coupling means indicated at 13, 15 and 17. In the last named coupling means the control grid and cathode circuits only are outlined for the purpose of simplifying the drawing, the grid leads of the radio frequency amplifier, combined detector-oscillator and intermediate frequency amplifier being indicated, respectively, at 19, 21 and 23, while the cathode leads of the same tubes are indicated at 25, 27 and 29, respectively. A variable resistor 70 in circuit with the leads 25 and 29 to ground serves as a manual sensitivity control means for the receiver.

The second detector is provided with an amplifier portion and a rectifier portion, the amplifier portion comprising a cathode 31, a control grid 33 and an output anode 35. In the present example, the tube is of the pentode type and further comprises a screen grid 37 and a suppressor grid 39. A heater for the cathode is indicated at 41.

The detector portion comprises two diodes 43 and 45 associated with the cathode 31, the diode 43 being utilized as the detector and automatic volume control diode, and for that purpose being connected with the preceding intermediate frequency amplifier 11 through a tuned input circuit 47 comprising the secondary of the interstage coupling transformer 49. In the present example the combined detector amplifier is of the double-diode pentode type and may be considered as an RCA 6B7 type of tube.

The tuned input circuit is completed through a filter resistor 51, a lead 53, a volume control resistor 55, and the cathode through a return lead 57. The rectified or detected signal and the direct current component thereof appear across the resistor 55. The resistor is suitably tapped at 59 and provided with a connection 61 to sup-

ply automatic volume control potentials to the leads 19, 21 and 23, the connection being made through suitable two point switches indicated at 63 and 65, as shown.

It will be noted that the switches 63 and 65 are provided with contacts 67 for connecting the leads 19, 21 and 23 to a point 69 adjacent to the cathode 31, whereby no automatic volume control potentials are available for said leads. With this arrangement the radio frequency amplifier 7, the combined oscillator-detector 9 and the intermediate frequency amplifier 11 may selectively be placed under automatic volume control of the diode rectifier or detector or may be placed under manual control only by means of the sensitivity control device 30 of the receiver.

The rectified signal available across the resistor 55 is impressed upon the control grid 33 through a shielded connection lead 71 having a variable potentiometer tap connection 73 with the resistor 55. A coupling condenser 75 is provided in the lead 71 and a connection to ground through a bias supply resistor 77 is made with the lead 71, whereby a fixed biasing potential is placed upon the control grid 33 from a suitable source such as a self bias resistor 79 in the cathode lead 57. The audio frequency output from the amplifier portion is then supplied to other amplifier means, indicated at 81, through an output anode lead, indicated at 83, for supplying amplified signals to a suitable output or loudspeaker device indicated at 85. As the amplifier means per se does not concern the invention, further description thereof is not believed to be necessary.

The biasing potential available across the self bias resistor 79, or other suitable source for the control grid 33, is also applied to the second diode anode 45 and, in the present example, is readily applied thereto by connecting the same to ground through a lead 87 and a coupling resistor 89.

It has been found that with this circuit arrangement, oscillations or signal voltage from any other source may be impressed upon the second diode anode 45 and will modulate the signal input through the circuit 47 on the first diode anode 43, so that the combined output will appear in the output coupling resistor 55 and will be suitably amplified by the amplifier portion of the tube. Advantage may be taken of this feature in various circuits, involving mixing two signals through the diode rectifier tube.

It will be noted that the second diode anode, on which the signals to be mixed are impressed, is connected through the coupling impedance 89 with a source of potential negative with respect to the cathode, by a difference sufficient to prevent rectification of the oscillations impressed thereon. In the present example, the second or mixing diode 45 is negative with respect to the cathode by the same amount as the control grid 33. Suitable values for the various resistors are as follows: Resistor 51 equal to 60,000 ohms; resistor 55 equal to 250,000 ohms, total; resistor 79 equal to 4,000 ohms; resistor 89 equal to 50,000 ohms and resistor 77 equal to 2 megohms.

In the present example, for unmodulated continuous wave reception, an oscillator of suitable construction is provided, as indicated at 91, anode current being supplied to the oscillator tube 93 through a supply lead 95 and output oscillations being taken from the output anode circuit, indicated at 97, through a shielded lead 99 in which is inserted a suitable coupling condenser 101 preferably variable, as indicated, to control the oscillator output. The oscillator is energized by closing the plate supply lead through a series switch 103 whereupon oscillations at the intermediate or other selected frequency are supplied through the coupling condenser 101 and the supply lead 99 to the second or mixing anode 45 across the impedance of the coupling resistor 89.

Any suitable source of oscillations may be employed for supplying the mixing anode 45. In the present example, the oscillator shown, provides a beat frequency for unmodulated continuous wave reception. The coupling with the signal circuit is, in any case, provided by the mixing diode anode 45 associated with the signal rectifier anode 43 and the cathode 31.

An advantage of the present mixing system in connection with an automatic volume control circuit will be apparent from the fact that, in the absence of received signals, oscillations impressed upon the signal diode may not be rectified and appear effectively across the resistor 55 and to be applied to the radio frequency and other amplifiers to reduce the gain therein. It has been found that by coupling to the auxiliary diode anode in the manner shown, the oscillator signals have less effect upon the automatic volume control system in the absence of received signals, whereby the receiving apparatus is maintained at a high degree of sensitivity as is normal for a receiver with automatic volume control means, but without additional signal input from another source.

Stated in other words, it has been found that coupling to the auxiliary diode anode while maintaining the same at a suitable negative potential with respect to the cathode, is effective to mix the two signals without rectification of the oscillations impressed on said diode anode.

The system thus described has many advantages in radio receiving apparatus and the like, for supplying modulation signals or oscillations to a diode type of rectifier in a signal circuit. The present system as described has the advantage that the oscillator may readily be placed in operation by closure of the switch 103 and when out of operation has substantially no effect upon the normal operation of the receiving system.

The power supply unit for the receiver includes a full-wave rectifier device 105 having anodes 107 and 109 connected with the terminals of a high voltage secondary winding 111 on the power supply transformer 113. The full-wave center tap connection 115 for the secondary 111 is connected to ground through a "stand-by" switch 117. The cathode 119 of the rectifier is supplied with filament potential from a secondary winding 121 to which is connected the filter choke coil 123. This may be the loudspeaker field winding.

The potential divider resistor is indicated as comprising three sections 125, 127, 129, all being connected in series between the choke coil 123 and ground. The transformer 113 is also provided with a secondary winding indicated at 131 for supplying the filaments and heaters of the receiving apparatus throughout and the transformer receives power through the primary indicated at 133.

The screen grid 37 of the combined detector amplifier 5 is connected through a supply lead 135 with a tap point between the resistor sections 127 and 129, while the supply lead 95 for the oscillator is connected to a tap point between the resistor sections 125 and 127, the tap points being for the purpose of supplying a lesser potential than the full potential of the supply means, as is well

known. The full plate supply for the intermediate frequency amplifier 11 is taken through a supply lead 137 connected with the positive output terminal of the supply means indicated at 139.

The power supply arrangement is such that with the receiver energized, the cathodes are maintained in an operating condition as a load on the power transformer 113, while the plate potential is removed by opening the center tap connection for the high voltage secondary through the "stand-by" switch 117. Therefore, operation of the stand-by switch instantly places the receiver in condition for operation or renders it instantly inoperative to receive signals as is desired.

From the foregoing description, it will be seen that an improved receiver is provided for modulated and unmodulated continuous wave signal reception by providing an improved oscillator coupling circuit in connection with the second detector of the diode rectifier type, providing automatic volume control potentials, and that the receiver is additionally provided with means for rapidly placing the oscillator and the receiver in a condition of full operation or non-operation, the change being effected by simple switching means, and that means are further provided for disconnecting the amplifier system from the automatic volume control means for unmodulated continuous wave reception, the manual control means being depended upon for volume control purposes in the reception of continuous wave signals.

The double-diode pentode type of tube, such as an RCA 6B7, is preferably utilized with one diode as a signal rectifier and preferably without bias or delay potential, while the second diode is negatively biased to prevent rectification, and connected or coupled to a source of oscillator voltage through a high resistance to ground, whereby no appreciable drop is caused in the normal sensitivity of the receiver due to rectification in the automatic volume control circuit, nor loading on the driving or input transformer circuit for the rectifier. As the wiring to the beat oscillator is not connected to the high potential side of the signal diode circuit, radiation of high frequency energy to other circuits is minimized and no increase in distributed capacity is caused in the tuned input circuit to the detector.

This system is readily adapted for mixing two signals in differing channels wherein one of the channels is provided with a diode rectifier. The system has the further advantages that it requires no changes in grid bias potential on the tube operating as the mixer tube. The normal operating conditions and efficiency of the system is unimpaired by the introduction of the additional signal frequency and no circuit changes such as circuit constants and voltages are necessary to permit adapting a modulated wave receiver for reception of continuous wave unmodulated signals.

The present system, therefore, provides an effective means of combining a given oscillator voltage and a signal voltage to produce, in conjunction with a double diode amplifier device, a resultant beat voltage without undesired loading effects or re-radiation effects due to wiring.

We claim as our invention:

1. The combination with an electric discharge amplifier device having a cathode and two diode anodes providing a double diode rectifier with said cathode, of means for applying signal modulated electrical oscillations to be rectified between one of said anodes and the cathode, means for applying unmodulated electrical oscillations at a differing frequency between the other of said anodes and the cathode, biasing means connected with said last named anode for preventing rectification in connection with the cathode of said additional oscillations thereby, and an output circuit for said device.

2. In a radio receiving system, the combination of an electric discharge amplifier device having a cathode and two diode anodes adjacent thereto, a rectifier circuit including signal input means and a potential drop producing impedance means connected between the cathode and one of said anodes, means for deriving automatic volume control potentials from said impedance means, means for deriving detected signals from said impedance means, an oscillator coupled to the other of said diode anodes, means for maintaining said last named anode at a negative potential with respect to the cathode, operating current supply means for energizing the oscillator and amplifier including the cathodes of said oscillator and amplifier, and means for deenergizing said oscillator and amplifier while said cathodes are energized.

3. The combination with means providing an electric signal amplifying channel, of a signal detector therein comprising an electric discharge device having a diode anode and a cathode, means for impressing signals on said channel through said detector, including a separate diode anode in said detector adjacent to said cathode and first named anode, coupling means in circuit with said second anode, and means for impressing a negative biasing potential greater than the peak signal amplitude on said second anode with respect to the cathode, whereby said signals are prevented at all times from being rectified.

4. In a radio receiving system, the combination with an electric discharge device having a cathode and two rectifier anodes adjacent thereto, of means for impressing signals to be rectified on one of said anodes, means for causing said anode to rectify said signals, amplifier means for the rectified signals, means including a control circuit in said system for utilizing the direct current component of the signal, means for impressing additional signals at a differing frequency on the other of said anodes, and means for preventing said last-named anode from rectifying said last named signals.

5. In a superheterodyne receiving system, the combination with a second detector comprising a cathode and a diode anode adjacent thereto, of an auxiliary oscillator, means for energizing said oscillator, means for tuning said oscillator to produce a beat frequency with signals received by said second detector, and means for coupling said oscillator to said second detector comprising a second diode anode adjacent to said cathode and having a connection with said oscillator.

6. In a superheterodyne receiving system, the combination with a second detector comprising a cathode and a diode anode adjacent thereto, of an auxiliary oscillator, means for energizing said oscillator, means for tuning said oscillator to produce a beat frequency with signals received by said second detector, and means for coupling said oscillator to said second detector comprising a second diode anode adjacent to said cathode and having a connection with said oscillator, said oscillator energizing means comprising a source of anode potential, a source of cathode potential,

and a switch for controlling the anode potential independently of the cathode potential.

7. In a radio receiving system, the combination with a diode detector comprising a cathode and an anode, of a detector output impedance, an automatic volume control circuit connected therewith, and means for impressing upon said detector additional signals at a differing frequency from the signal frequency without causing variation in the potential applied to said automatic volume control circuit, said means comprising an oscillator tunable to a frequency differing from the signal frequency and having an output circuit, and an additional diode anode adjacent to said cathode of the detector and separate from said first named diode anode, said additional diode anode being connected to said oscillator output circuit.

8. In a radio receiving system, the combination with a signal rectifier of the diode type and an oscillator for producing a beat frequency with received signals, said oscillator being tunable, of means for coupling said oscillator to said rectifier without appreciably affecting the tuning of said oscillator, said means comprising a second diode rectifier having a cathode in common with the first named rectifier and means for biasing said last named rectifier whereby it is prevented from rectifying signals received from said oscillator.

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