

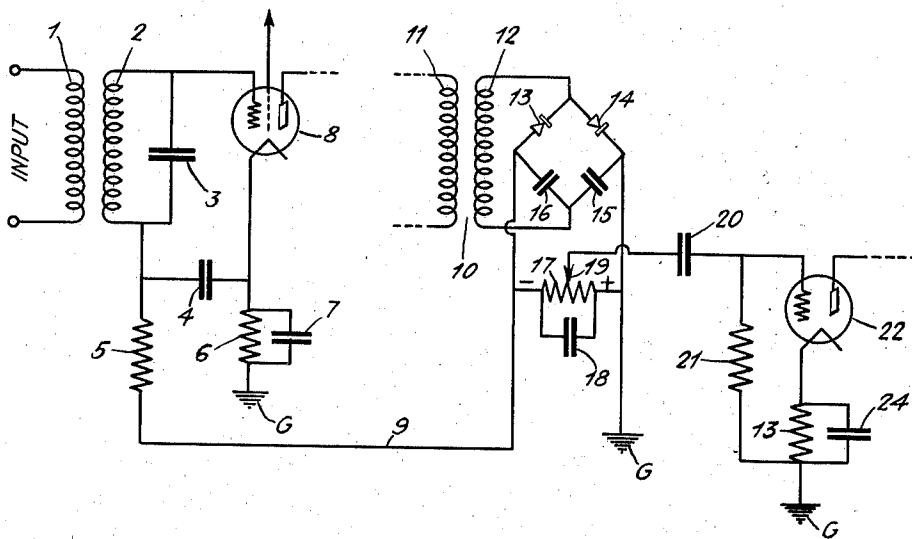
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VOLTAGE DOUBLER CIRCUIT

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VOLTAGE DOUBLER CIRCUIT

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The present invention relates to radio receiving apparatus, and is particularly directed to that part of such apparatus which is concerned with the detection of the received high frequency signal impulses.

When a modulated carrier frequency oscillation is applied to the input circuit of a high frequency detector, there appears in the output circuit thereof a complex current comprising, among other components, a direct current proportional to the strength of the received carrier oscillation, and, superposed thereon, an alternating current due to the modulation frequencies. The alternating current is separated from the direct component and is applied, usually after suitable amplification, to a signal utilizing device. In a broadcast receiver, the amount by which the modulation frequency oscillations must be amplified is determined by the efficiency of the signal detector, and by the alternating voltage required to load sufficiently the power output stage.

It has been proposed, for the purpose of automatic volume control, to utilize a direct current potential derived from the direct current component of the current in the output circuit of the signal detector to control the amplification of the receiver as a whole, with the object of maintaining the output from the receiver at a substantially constant level, independent of fluctuations in the strength of the received signal. In order that automatic volume control may be obtained over a large range of input signal strength, it has been found necessary in many cases to amplify the direct current controlling potential derived from the output circuit of the signal detector.

It has also been proposed to utilize a separate detector for obtaining the automatic volume control potential, and it has been suggested in such a system that the separate detector should be biased in such a manner that no detection takes place, and no control potential is thus produced, until the input signal strength reaches a certain predetermined value. It will be apparent that, in such a system, the range of control potentials available for automatic volume control purposes will be reduced.

It is an object of the present invention to provide an improved signal detector for radio receiving apparatus.

According to the present invention, a radio receiver comprises a voltage doubling circuit arrangement adapted to act as a signal detector.

According to a feature of the present invention, a radio receiver comprises a voltage doubling circuit arrangement adapted to rectify the received signal impulses, wherein a direct current potential due to said signal impulses is derived from said voltage doubling circuit and is utilized for controlling the amplification of the receiver as a whole.

It will be clear that the use of a voltage doubling signal detector confers the advantage that the amount of modulation frequency amplification required is reduced; in certain cases it may be possible to feed the modulation frequency output of the signal detector directly to a power output stage.

By the use of a voltage doubling rectifier to provide the automatic volume control potential, the advantage is obtained that a greater range of control potential is made available. The rectifier may then be arranged to produce no control potential until a certain threshold value of signal input strength is reached without reducing the efficiency of the automatic volume control.

In the following description, the invention will be described as applied to a superheterodyne receiver having a second detector adapted also to provide automatic volume control potentials.

The secondary winding 12 of an intermediate frequency transformer 10, the primary winding 11 of which is connected in the anode circuit of an intermediate frequency amplifying valve, is connected across one diagonal of a four-armed bridge, the arms of which are constituted by two contact rectifiers 13, 14 of any suitable type and two condensers 15, 16 of low capacity. To one end of the secondary winding is connected one pole of one of the rectifiers, and the complementary pole of the other, the bridge circuit being completed through the two condensers, each of which has one pole connected to the other end of the secondary winding.

Across the other diagonal of the bridge is connected a potentiometer resistance 17 of about 500,000 ohms for example, which is provided with a variable tapping point 19, and is shunted by a condenser 18 which has a low impedance to radio-frequency currents, and high impedance to audio-frequency currents.

The bridge circuit described acts as a voltage doubling detector, the input circuit of which comprises the secondary winding 12 of the intermediate frequency transformer 10, and the output circuit of which comprises the potentiometer resistance 17. The modulation frequency oscillations are taken off from the potentiometer at the variable tapping point 19, and are fed, preferably through a suitable filter circuit such as condenser

20, to the grid circuit of a low frequency amplifier 22. The direct current due to the received carrier frequency oscillations sets up a potential difference across the potentiometer; the positive end of the potentiometer is earthed as at G, and the control potential is taken from a point at or near the negative end, and applied, if desired through a suitable filter circuit 5, 4, to control the amplification of the receiver 8 in any known or suitable manner. Tube 8 represents generally a R. F. amplifier or a I. F. amplifier or both.

The above described arrangement is described solely by way of example, and it will be apparent that many modifications within the scope of the invention may be introduced. Rectifiers other than dry contact types may be employed, for example, and thermionic rectifiers such as diode valves may be used. Various methods of feeding the rectifier other than by means of a transformer may also be employed; for example, the rectifier may be coupled to the intermediate frequency amplifying valve by means of a choke-capacity coupling. It will also be apparent that the invention is not limited to superheterodyne receivers.

If desired, a radio receiver may have a signal detector of any known or suitable type, and a voltage doubling detector employed in accordance with the invention to provide only the automatic volume control potential. A fixed bias voltage may be applied to the rectifier which produces the automatic volume control potential, that is to say, either the signal detector or the separate rectifier of the control potential circuit, in order to delay the generation of the control voltage until a signal strength of greater than a predetermined value is reached.

I claim:

1. In a superheterodyne receiver, a high frequency amplifier including an electronic tube provided with an anode, a cathode and at least one grid electrode, a low frequency amplifier provided with an electronic tube having an anode, a cathode and at least one grid electrode, a detector device intermediate the high frequency and low frequency amplifier said detector device being provided with input and output circuits, said detector device comprising a four-arm bridge circuit including two rectifier devices connected in adjacent arms of the bridge circuit and two condensers of relatively low capacity connected in the other two adjacent arms of the bridge, means for coupling the high frequency amplifier output to the detector input circuit comprising a connection between a point which is common to the two rectifier arms of the bridge and a point which is common to the two condenser arms of the bridge, said connection forming one of the diagonals of the bridge, the other diagonal of the bridge including a resistance element of the order of 500,000 ohms, means for coupling the detector output to the low frequency amplifier input comprising a connection, including a condenser between a point of said resistor and the grid electrode of the second named thermionic tube, a low impedance path for high frequencies comprising a condenser shunted across the resistor and a connection from the grid electrode of the first named thermionic tube to the cathode thereof, said connection including the resistor element whereby said first named thermionic tube is biased in accordance with the flow of current through said resistor element to thereby control the amplification characteristics

of said first named tube in accordance with the detector output.

2. In a signalling system, a vacuum tube amplifier having a cathode and a grid-electrode, a voltage multiplier rectifying circuit said rectifying circuit being provided with an input circuit and an output circuit, means for coupling the input circuit to the amplifier, said output circuit including an impedance device across which there is developed a unidirectional voltage drop due to the flow of rectifier output current there-through, the voltage developed across the impedance device being a multiple of the voltage impressed upon the input of the rectifier, a circuit connection between the cathode of the tube and a point of the impedance which is in the vicinity of the positive end thereof, said connection including a bias resistor and a connection between the grid-electrode of the tube and a point of the impedance device which is in the vicinity of the negative end thereof.

3. A system as described in the next preceding claim wherein said voltage multiplier rectifying circuit includes two rectified elements arranged to form a bridge with two capacity elements, one of the diagonals of the bridge forming the input circuit and the other diagonal forming the output circuit.

4. In a signalling system, a vacuum tube amplifier having a cathode and a control electrode, a detector circuit provided with an input circuit and an output circuit, means for coupling the input circuit to the amplifier, said output circuit including an impedance device across which there is developed a unidirectional voltage drop due to the flow of rectifier output current there-through, means for connecting a point in the vicinity of the positive end of said impedance to ground, means for providing a direct current connection between a point of said impedance which is negative relative to the grounded point thereof and said control electrode and means for connecting the cathode to ground including a bias impedance device whereby there is provided a direct current connection between the cathode and the control electrode including said bias impedance and at least a part of said impedance device said detector circuit comprising a pair of rectifiers and a pair of reactances, said rectifiers and reactances being connected so as to form a bridge circuit, one of the diagonals of the bridge comprising the input circuit of the detector circuit and the other diagonal of the bridge comprising the output circuit of the detector circuit.

5. In a signalling system, a vacuum tube amplifier having a cathode and a grid electrode, a detector circuit provided with an input circuit and an output circuit, means for coupling the input circuit to the amplifier, said output circuit including an impedance device across which there is developed an unidirectional voltage drop due to the flow of rectifier output current there-through, means for connecting a point in the vicinity of the positive end of said impedance to ground, means for providing a direct current connection between a point of said impedance which is negative relative to the grounded point thereof and the grid electrode, means for connecting the cathode to ground including a bias impedance device whereby to provide a direct current connection between the cathode and the grid electrode, said connection including the bias impedance and at least a part of said impedance device, a second vacuum tube provided with a

grid electrode and a cathode means for connecting the last named grid electrode to a point of the impedance device, said means including a coupling condenser, a connection between the last named cathode and ground, said connection including an impedance element and means including a resistance device for connecting the last named grid electrode to ground said detector circuit comprising a pair of rectifiers and a pair of reactances, said rectifiers and reactances being connected so as to form a bridge circuit, one of the diagonals of the bridge comprising the input circuit of the detector circuit and the other diagonal of the bridge comprising the output circuit of the detector circuit.

6. In a signal modulated carrier wave receiving system which includes a high frequency amplifier having an electronic tube provided with anode, cathode and grid electrodes, a low frequency amplifier and a detector circuit intermediate the two amplifiers, said detector circuit comprising a voltage doubler device including two rectifier elements and two capacity elements arranged to form a bridge circuit, one of the diagonals of the bridge forming the input circuit of the detector circuit and the other diagonal, the output circuit thereof, a resistor element shunted across the output circuit, a connection from the low frequency amplifier input to a point on said resistor, said connection including a coupling capacity, a low impedance path for high frequencies effectively across said resistor element, a connection from one end of the resistor element to the grid electrode of the high frequency amplifier, and means for connecting the other end of said resistor to ground whereby a bias voltage is provided for the high frequency amplifier, said bias voltage being variable in accordance with the intensity of the carrier wave.

7. The combination, in an automatic volume control circuit for tuned high frequency receivers, of an amplifier in the tuned signal channel of said receiver, means to produce a unidirectional voltage for control of said amplifier, said means comprising a rectifier, and means to impress oscillations from said channel on said rectifier, said rectifier including means to produce a unidirectional voltage of substantially double the peak value of oscillations supplied thereto, and means to control the amplification of said amplifier in response to a portion of said unidirectional voltage greater than the peak value of said oscillations.

8. In a radio receiver, the combination with a carrier wave amplifier of a voltage doubler circuit including a pair of rectifier units each thereof having an anode and a cathode, an input circuit for the voltage doubler circuit upon which the carrier wave output of the amplifier is impressed, said input circuit being connected between the cathode and anode of each of the rectifier units, each connection including respectively a condenser, the two condensers being connected in series between the anode of one of the rectifier units and the cathode of the other

thereof, an output impedance element shunted across the two series condensers whereby there is developed across the output impedance element the substantially double voltage rectified output, means for connecting one end of the output impedance element to a point of fixed potential, means including a direct current circuit connected between a point near the other end of the impedance element and the carrier wave amplifier for automatically varying the gain of the amplifier as a function of the voltage developed across the output impedance, an audio frequency network input terminal and means including a coupling condenser for connecting said input terminal to a point of the output impedance element whereby audio signal energy is obtained from the voltage doubler circuit.

9. In a signalling system a vacuum tube amplifier having a grid electrode, a voltage multiplier rectifying circuit, said rectifier circuit being provided with an input circuit and an output circuit, means for coupling the input circuit to the amplifier, said output circuit including an impedance device across which there is developed a uni-directional voltage due to the flow of rectifier output current therethrough, the voltage developed across the impedance device being a multiple of the voltage impressed upon the input of the rectifier, a connection between a point of the impedance which is in the vicinity of the positive end thereof and ground and a connection between the grid electrode of the tube and a point of the impedance device which is in the vicinity of the negative end thereof.

10. A system as described in the next preceding claim characterized by that the voltage multiplier rectifying circuit includes two rectifier elements arranged to form a bridge with two capacity elements, one of the diagonals of the bridge forming the input circuit and the other diagonal forming the output circuit.

11. In a signal modulated carrier wave receiving system which includes a high frequency amplifier having an electronic tube provided with anode, cathode and grid electrodes, a low frequency amplifier, a detector circuit intermediate the two amplifiers, said detector circuit comprising a voltage doubler device including two rectifier devices and two capacity elements arranged to form a four-arm bridge circuit, one of the diagonals of the bridge forming the input circuit of the detector circuit and the other diagonal the output circuit of the detector circuit, a resistor shunted across the output circuit, a connection from the low frequency amplifier input to a point of said resistor, said connection including a coupling capacity, a connection from one end of the resistor element to the grid electrode of the high frequency amplifier tube, and means for connecting the other end of the resistor to ground whereby a bias voltage is provided for the high frequency amplifier tube, said bias voltage being variable in accordance with the intensity of the carrier wave.

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