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MODULATOR

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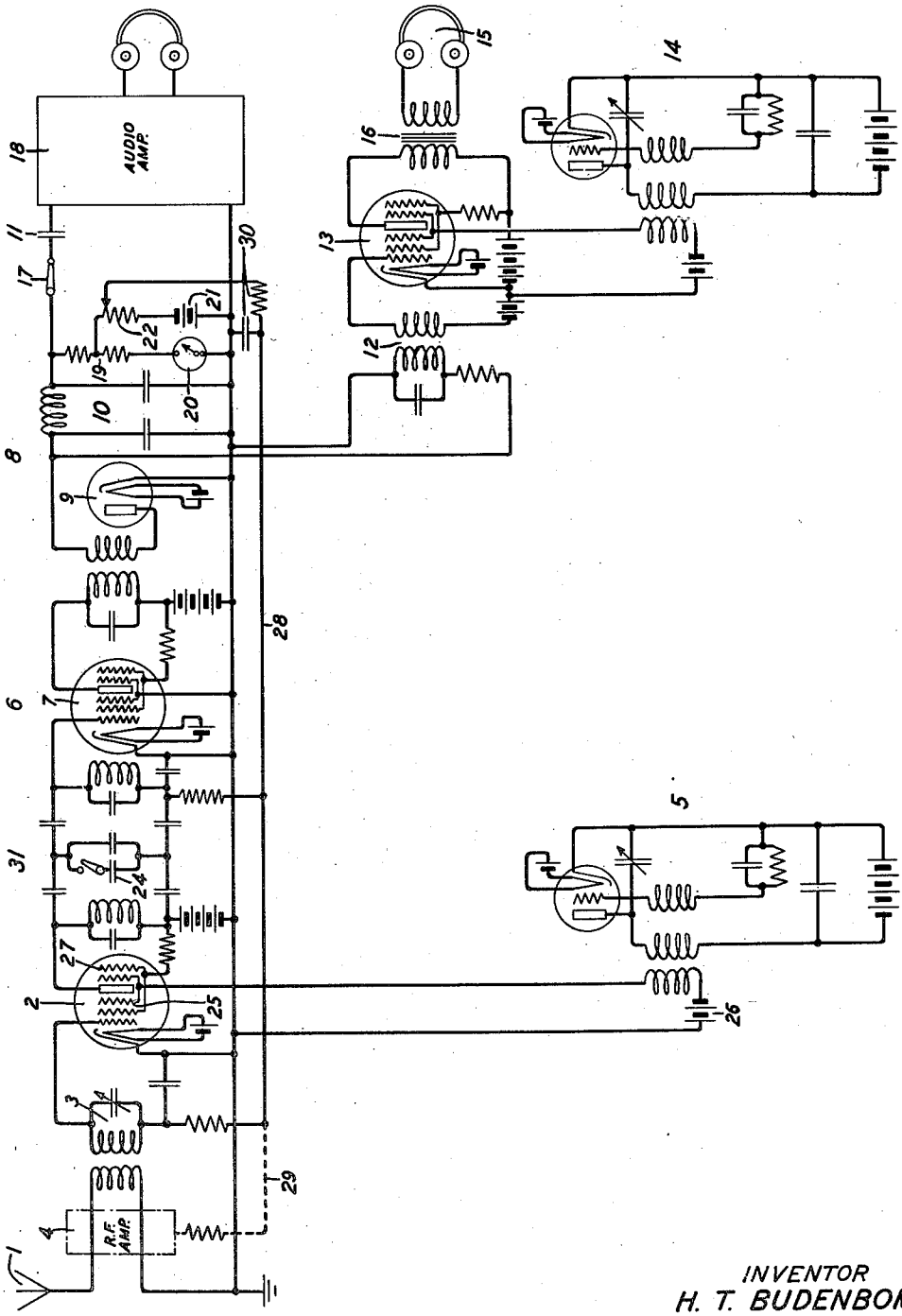

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MODULATOR

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2 Claims. (Cl. 250—20)

This invention relates to modulators and detectors, particularly to detectors, for use in radio receivers of the heterodyne or superheterodyne type.

An object of the invention is to simplify and improve the efficiency of heterodyne and superheterodyne detectors.

In a specific preferred embodiment this invention comprises a radio receiver of the superheterodyne type for receiving either telephone or telegraph signals. The high frequency modulator or detector in which the received radio waves are combined with waves from a local oscillator to produce the intermediate frequency wave comprises a vacuum tube of the pentode type having a cathode, a control grid, an anode, a screen or shield grid and a suppressor grid mounted between the shield and anode to prevent secondary emission from the anode. The received radio waves are supplied to an input circuit connected between the control grid and the cathode. The heterodyning waves are supplied to a second input circuit connected between the suppressor grid and cathode. A constant direct current biasing electromotive force is applied between the suppressor grid and cathode to maintain the suppressor grid negative with respect to the cathode, both to eliminate secondary emission from the anode to the shielding grid and to produce an effective amplification of the locally generated waves. The intermediate frequency waves representing the difference between the locally generated waves and the received radio waves are selected in a selective circuit connected between the anode and cathode and supplied to an intermediate frequency amplifier of the usual type. The output of the intermediate frequency amplifier is rectified and the direct current component of the rectified current employed for automatic volume control, being applied to the control grids of the high frequency detector and intermediate frequency amplifier tubes.

For telephone reception, the audio-frequency component of the rectified intermediate frequency waves is amplified in an audio-frequency amplifier of the usual type. For telegraph reception, the output of the intermediate frequency amplifier is supplied to a heterodyne detector which comprises a tube of the same type as that employed in a high frequency detector. The amplified intermediate frequency wave is supplied to an input circuit connected between the control grid and cathode and the heterodyne waves, differing in frequency from the intermediate frequency wave by an audible frequency, is supplied to a second input circuit connected between the cathode and the suppressor grid thus producing in the plate circuit an audible frequency which corresponds to the telegraph modulation at the transmitter.

The use of this pentode type modulator in both the superheterodyne and heterodyne detectors produces certain advantages among them, the localization of the heterodyning waves in the suppressor grid and anode circuits due to the fact that the heterodyne waves are supplied to the suppressor grid which is shielded from the regular control grid by the shielding grid. This eliminates any possibility of reradiation or deleterious effect on the tuning of the input circuit in the case of the high frequency detector, and prevents the heterodyne wave from being impressed upon the intermediate frequency circuit to nullify the action of the automatic gain control circuit in the case of the heterodyne detector. At the same time there is a considerable amplification factor between the suppressor grid and the anode so that the heterodyne waves are in fact amplified thus reducing the design requirements on the heterodyne oscillators.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing which shows one embodiment thereof in a superheterodyne radio receiver for telephone and telegraph reception.

The radio receiver shown is of the superheterodyne or double detection type employing modulators of this invention in the high frequency detector and heterodyne telegraph detector circuits. The waves received in the antenna 1 are supplied to the input of a high frequency detector tube 2 through a tuned input transformer 3 which provides radio frequency selectivity. If further preselection is desired a tuned radio frequency amplifier 4 may be inserted ahead of the high frequency detector.

In the high frequency detector the received radio waves are combined with the waves from a beating oscillator 5 of the conventional tuned plate circuit type to produce intermediate frequency waves. The circuit of the high frequency detector tube 2 will be described in detail hereinafter.

The resultant intermediate frequency waves are selectively amplified in an intermediate frequency amplifier 6 herein represented as a single radio frequency pentode type amplifier tube 7 with an intermediate frequency filter 31. Obviously, additional amplifier and filter stages may be employed.

The output of the intermediate frequency amplifier is supplied to a low frequency detector circuit 8 which employs a two-electrode tube 9. A low pass filter 10 is provided for eliminating the high frequency current from the rectifier output. An output resistance 19 is connected in series with a tuning meter 20 to the output of the filter 10. The audio-frequency voltage developed across the resistance 19 is supplied to an audio-frequency amplifier 18 through a switch 17 and blocking condenser 11.

The direct current voltage developed across the resistance 19 is supplied to the control grids of the high frequency detector tube 2 and the intermediate frequency amplifier tube 7 through the resistance-condenser filter 30 and connection 28 for the purpose of automatic volume control. A battery 21 and control potentiometer 22 provide means for adding varying amounts of negative bias in series with the automatic volume control voltage from the resistance 19. This provides a sensitivity control of the receiver permitting the elimination of much of the background noise. The tuning meter furnishes an indication of the output level and this control permits it to be maintained at a uniform value. The arrangement of this battery and poteniometer also permits the adjustment of volume control voltage to be made without varying the direct current voltage across the resistance 19 thus permitting that voltage to be used for other control purposes such as noise prevention circuits without the operation of such circuits being affected by the sensitivity control of the receiver.

If a radio frequency amplifier is used the automatic control may also be supplied thereto through the connection 29.

In order to permit the reception of continuous wave telegraph signals a heterodyne detector 13 is provided. This detector employs a pentode type modulator circuit of this invention, the input to which is supplied through a tuned input transformer 12 which is connected to the input to the low frequency detector 8 to receive the amplified intermediate frequency waves. The heterodyne oscillations are supplied from a beating oscillator 14 and are combined in the tube 13 with the intermediate frequency waves, producing an audio frequency beat which is supplied through output transformer 16 to headphones 15.

If the receiver is used in a telephone system with a subscriber's line connected to the output of the audio amplifier 18, the operator may use the heterodyne detector to check the radio receiver tuning without disturbance to the subscriber.

When used for telegraph reception the band width of the intermediate frequency filter 31 may be narrowed by connecting the auxiliary condenser 24 in shunt to the regular coupling condenser. Also the time constant of the gain control circuit may be slowed by changing the values of resistance and capacity of the filter 30.

The methods of operation of the pentode type modulator circuits used in the high frequency detector and heterodyne detector circuits are identical so that only the high frequency modulator circuit will be described in detail. In this circuit the received radio frequency waves are supplied between the cathode and control grid. The beating waves from the oscillator 5 are supplied between the cathode and suppressor grid 25 which is biased negatively with respect to the cathode by the battery 26. The shield grid 27 prevents the beating waves from being impressed on the input circuit of the modulator thus eliminating any reaction of these waves on the input circuit and preventing their reradiation. The beat waves produced by the interaction of the received waves and the oscillations from the beating oscillator are taken off through the output circuit connected between the anode and cathode. Since both the control grid and suppressor grid introduce amplification factors with respect to the anode, both the received waves and beating oscillations are effectviely amplified in the modulator tube. This effective amplification of the beating oscillations greatly reduces the power demand on the beating oscillator thereby contributing to the efficient operation of the circuit.

While separate batteries are shown for supplying the various electrode voltages it should be understood that these voltages may be obtained from a common source such as a rectifier through the use of a voltage dividing resistance.

What is claimed is:

1. In a signal receiving and translating system, a bias controlled modulator stage comprising a vacuum tube having a cathode, an anode and at least two grids interposed between the anode and cathode, one of said grids having impressed thereon the signal voltage and the bias control voltage, said other grid having impressed thereon an alternating voltage, whereby space-path modulation is effected in said tube, means responsive to the output of said modulator for causing said bias voltage to automatically vary in proportion to the received signal intensity, whereby the output of said modulator stage is maintained more nearly constant than the input over a wide range of received signal intensities.

2. In a superheterodyne receiver a modulator system comprising a vacuum tube having a cathode, an anode, a first control grid, a shielding grid and a second control grid, said grids being interposed in the space path in the order named from said cathode to said anode, a signal input circuit connected between one of said control grids and said cathode, a modulated signal output circuit connected between said anode and said cathode, a source of positive voltage applied to said shielding grid, a source of oscillations connected between the other of said control grids and said cathode, means for developing a bias voltage which becomes more negative when the signal intensity increases, and means for impressing said voltage on said one of said control grids thereby maintaining the output intensity in said modulated signal output circuit more nearly constant than the input intensity over a considerable range of input signal intensities.

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