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TUNING INDICATION CIRCUIT

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The diagram illustrates a radio receiver circuit with the following components and connections:

- I.F. AMPL. (1):** The first vacuum tube stage, which is coupled to the I.F. source and the AVC section.
- TO I.F. SOURCE:** A connection point for the intermediate frequency signal source.
- AVC (Automatic Volume Control):** A section that includes a variable capacitor (13) and a resistor (14) for controlling the volume of the signal.
- 2nd DET. (2nd Detector):** The second vacuum tube stage, which is coupled to the I.F. amplifier and the A.F. amplifier.
- A.F. AMPL. (A.F. Amplifier):** The third vacuum tube stage, which is coupled to the 2nd detector and the output.
- Other components:** The circuit includes various capacitors (4, 5, 6, 7, 8, 9, 10, 11, 12, 15, 16, 17, 18, 19), inductors (3, 13), and resistors (14, 15, 16, 17, 18, 19) that form the tuning and coupling network.

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TUNING INDICATION CIRCUIT

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This invention relates to a circuit arrangement for determining the tuning of superheterodyne receiving sets.

As is well known, tuning of wireless receiving sets having automatic volume control is rendered difficult by the fact that the correct tuning of the set to the carrier wave to be received cannot be found by adjusting to maximum sound strength, which is customary with receiving sets without automatic volume control; for the operation of the automatic volume control is such that the sound strength is kept constant within fairly wide limits independently of the tuning.

It will be remembered that this difficulty is also encountered in tuning receiving sets without automatic volume control, if these sets have a substantially rectangular resonance curve. This difficulty can be avoided by resorting to so-called visible tuning control by means of which the correct tuning of the receiving set is indicated in such a manner that it can be perceived by the eye. Preferably, it is used in sets having automatic volume control in which case the tuning indicating device such as a milliammeter, is interposed in the anode circuit of a high, or intermediate, frequency amplifying tube, whose grid bias is acted upon by the automatic volume control.

However, such visible tuning control is sometimes, also, used in sets without automatic volume control, and whose resonance curve is shaped as that of a simple oscillatory circuit. In this case the device indicating the tuning is inserted in the anode circuit of the demodulating rectifier. In devices having a substantially rectangular resonance curve, it has already been suggested to control the indicating device with the aid of an auxiliary rectifier, and to couple the latter with the high, or intermediate, frequency amplifier through a very selective circuit.

In another method facilitating the tuning of radio-receiving sets having automatic volume control or of radio-receiving sets having a substantially rectangular resonance curve, an auxiliary rectifier is coupled with the high, or intermediate, frequency amplifier through a very selective circuit, a direct current voltage being derived from this auxiliary rectifier by which voltage the grid bias of an amplifying, or rectifying, tube of the receiver is controlled. The arrangement is such that when the receiver is excessively detuned with respect to the carrier wave to be received, the amplifying, or rectifying, tube will be blocked, whereas this blocking is removed on tuning the receiver to the carrier wave to be received.

As an alternative the said auxiliary rectifier may be used for controlling a relay by which the loudspeaker of the receiver, for instance, is put in circuit only with correct tuning. These circuit arrangements permit the set to be tuned aurally, since the incoming signal is reproduced or the sound strength is a maximum only with a correct tuning.

The circuit arrangement according to the invention comprises two rectifiers which are coupled with the intermediate-frequency amplifier in such a manner that one of the rectifiers is preceded by a greater selectivity than the other one. From both of the rectifiers a direct current voltage is derived whose difference serves to control the members facilitating or indicating the tuning.

In the drawing:

Fig. 1 is a circuit embodying the invention;

Fig. 2 shows an alternative arrangement.

An intermediate-frequency amplifying tube 1 is shown in Fig. 1 coupled with a rectifying tube 2 through a band-filter 3. The band-filter consists of two coupled oscillatory circuits 4 and 5, and is of such a nature that the oscillatory circuit 4 has a low selectivity, whereas the oscillatory circuit 5 has a very high selectivity. The intermediate-frequency oscillations amplified in the tube 1 are rectified by the rectifier 2, and produce a direct current voltage drop and a low-frequency alternating voltage across a resistance 6 in the rectifier circuit, this latter voltage depending on the modulation of the intermediate-frequency oscillations. The low-frequency alternating voltage is supplied through an adjustable contact 7 and a condenser 8 to the control grid of a low-frequency amplifying tube 9.

The arrangement comprises a second rectifying tube 10 which is coupled through a condenser 11 with the oscillatory circuit 4 of the band-filter 3. After rectifying the intermediate-frequency alternating voltage supplied to it, this rectifier produces a direct current voltage drop across a resistance 12, which controls the grid bias of the intermediate-frequency amplifying tubes through a suitable filter consisting of a resistance 13 and a condenser 14. In this way automatic volume control is obtained in a known manner. Due to this control the intermediate-frequency alternating voltage through the oscillatory circuit 4, and consequently also the voltage drop across the resistance 12 is kept substantially constant within wide limits and independently of the tuning, since the oscillatory circuit 4 has a low selectivity as has been stated above.

On the contrary, the intermediate-frequency

alternating voltage through the oscillatory circuit 5, and consequently also the direct voltage drop across the resistance 6, will strongly vary with the tuning on account of the high selectivity of the circuit 5. The selectivity of the circuit 5 may, for instance, be given such a value that an appreciable voltage drop across the resistance 6 occurs only when the detuning of the receiver with respect to the carrier wave to be received is less than 300 cycles.

The difference of the voltage drops across the resistances 6 and 12 controls the grid bias of the low-frequency amplifying tube 9 across a resistance 15. When the detuning of the receiver with respect to that of the carrier wave to be received amounts to more than 300 cycles, then substantially a voltage drop across the resistance 12 is available only. This voltage drop has such a value and direction that the low-frequency amplifying tube 9 is blocked so that the incoming signal is not reproduced. If the tuning of the receiver is altered to such a degree that the detuning is less than 300 cycles, a sufficient alternating voltage over the circuit 5 of the band-filter 3 is available, which voltage produces a direct current voltage drop across the resistance 6 which compensates the voltage drop across the resistance 12 in such a manner that the grid bias of the low-frequency amplifying tube 9 acquires its normal value at which this tube acts as an amplifier. Consequently the incoming signal can be reproduced by the receiver only when the detuning with respect to the carrier wave to be received is less than 300 cycles.

The condenser 8 should not have an excessive value, otherwise there would be a risk of the blocking of the low-frequency amplifying tube 9 not being removed upon quickly adjusting the tuning means. By adjusting the contact 7 of the resistance 6 the sound strength can be controlled by hand. However, the arrangement is such that the sound strength cannot be reduced completely down to zero, since even when the contact 7 occupies the extreme left position, a certain alternating voltage remains available across the condenser 8.

In the arrangement represented in Fig. 2, this draw-back is avoided. It will be readily seen that if in this arrangement the resistances 15 and 16 and the condensers 2 and 17 are equal the low-frequency alternating voltage between the points 18 and 19 becomes zero when the contact 7 occupies the extreme left position. In this position no low-frequency alternating voltage is supplied to the low-frequency amplifying tube 9. For using the circuit arrangement according to the invention, it is of little importance whether the receiving set be equipped with automatic volume control. In the arrangements shown in Figs. 1 and 2 the automatic volume control may be dispensed with without affecting their operation.

It is sometimes desirable to give both of the rectifiers of the arrangement according to the invention a different bias. The arrangements shown in Figs. 1 and 2 have the property of the low-frequency amplifying tube 9 being not blocked when signals are not received. Under these circumstances disturbing noises are reproduced. If, however, the rectifier 10 is given a positive bias, for instance, by interposing a source of current in series with the resistance 12, the resistance 12 is continually traversed by current even when signals are not received.

In this case the voltage drop across the re-

sistance 12 produced by this current may be given such a value that the low-frequency tube 9 is blocked. The circuit arrangements represented in Figs. 1 and 2 may also be used for visible tuning control. In this case the tube 9, for instance, is an auxiliary tube whose anode circuit comprises an indicating device such as a milliammeter. The correct tuning of the receiving set is then indicated by the maximum throw of this milliammeter.

Again it is possible to provide the anode circuit of the tube 9 with a relay which with an undue detuning of the receiver severs, for instance, the low-frequency amplifier from the preceding portion of the receiver or cuts the loudspeaker out of circuit. The circuit arrangements represented in Figs. 1 and 2 may also be altered in such a manner that instead of the low-frequency amplifying tube 9 an intermediate-frequency amplifying tube or the demodulation rectifier of the set is rendered inoperative with undue detuning of the receiver. In this case the tube 9 represents the intermediate frequency amplifying tube, or the demodulation rectifier.

What is claimed is:

1. In a high frequency wave transmission system of the type including at least two resonant circuits and a wave responsive tube, one of said circuits having a relatively sharper selectivity characteristic than the other and both circuits being tuned to a common wave frequency, means for deriving a direct current voltage from said other circuit when waves of approximately the tuned frequency are impressed on the system, means for applying said voltage to the responsive tube in a sense to render the latter inoperative, a second means for deriving a direct current voltage from said sharper circuit when waves are impressed on the system of a frequency substantially closer to said tuned frequency than said approximate frequency, means for applying the second direct current voltage to said responsive tube in a sense to nullify the effect of said first voltage, and additional means for utilizing said first voltage as an automatic gain control voltage for the system.

2. In a high frequency wave transmission system of the type including at least two resonant circuits and a wave responsive tube, one of said circuits having a relatively sharper selectivity characteristic than the other and both circuits being tuned to a common wave frequency, means for deriving a direct current voltage from said other circuit when waves of approximately the tuned frequency are impressed on the system, means for applying said voltage to the responsive tube in a sense to render the latter inoperative, a second means for deriving a direct current voltage from said sharper circuit when waves are impressed on the system of a frequency substantially closer to said tuned frequency than said approximate frequency, means for applying the second direct current voltage to said responsive tube in a sense to nullify the effect of said first voltage, said second deriving means being the wave demodulator, and said responsive tube having its input electrodes coupled to the demodulator to utilize the audio component of demodulated waves.

3. In a high frequency wave transmission system of the type including at least two resonant circuits and a wave responsive tube, one of said circuits having a relatively sharper selectivity characteristic than the other and both circuits being tuned to a common wave frequency, means

for deriving a direct current voltage from said other circuit when waves of approximately the tuned frequency are impressed on the system, means for applying said voltage to the responsive tube in a sense to render the latter inoperative, a second means for deriving a direct current voltage from said sharper circuit when waves are impressed on the system of a frequency substantially closer to said tuned frequency than said approximate frequency, means for applying the second direct current voltage to said responsive tube in a sense to nullify the effect of said first voltage, a wave transmission tube coupled to the broader of the two circuits, and means for controlling the gain of the transmission tube with said first voltage.

4. In a high frequency wave transmission system of the type including at least two resonant circuits and a wave responsive tube, one of said circuits having a relatively sharper selectivity characteristic than the other and both circuits being tuned to a common wave frequency, means for deriving a direct current voltage from said other circuit when waves of approximately the tuned frequency are impressed on the system, means for applying said voltage to the responsive tube in a sense to render the latter inoperative, a second means for deriving a direct current voltage from said sharper circuit when waves are impressed on the system of a frequency substantially closer to said tuned frequency than said approximate frequency, means for applying the second direct current voltage to said responsive tube in a sense to nullify the effect of said first voltage, each of said deriving means being a rectifier of the diode type, and an automatic gain control circuit being connected to the first voltage deriving diode.

5. In a superheterodyne receiver of the type including an intermediate frequency transmission network of at least two resonant circuits coupled in cascade, both circuits being tuned to the operating intermediate frequency and the second of the circuits being relatively sharper

in selectivity than the first, a rectifier coupled to the first circuit to produce a uni-directional voltage from wave energy whose frequency exceeds by a predetermined value the operating intermediate frequency, a second rectifier coupled to the sharper circuit to produce a second uni-directional voltage from wave energy whose frequency does not exceed by said predetermined value the intermediate frequency, an electron discharge tube responsive to received signals, means for applying said two uni-directional voltages to said responsive tube in polarity opposition thereby to render the operation of the tube dependent on the frequency of received signals, said second rectifier being the second detector, said responsive tube being coupled to the second detector to function as an audio amplifier, and means for controlling the audio energy transmission to said audio amplifier.

6. In a superheterodyne receiver of the type including an intermediate frequency transmission network of at least two resonant circuits coupled in cascade, both circuits being tuned to the operating intermediate frequency and the second of the circuits being relatively sharper in selectivity than the first, a rectifier coupled to the first circuit to produce a uni-directional voltage from wave energy whose frequency exceeds by a predetermined value the operating intermediate frequency, a second rectifier coupled to the sharper circuit to produce a second uni-directional voltage from wave energy whose frequency does not exceed by said predetermined value the intermediate frequency, an electron discharge tube responsive to received signals, means for applying said two uni-directional voltages to said responsive tube in polarity opposition thereby to render the operation of the tube dependent on the frequency of received signals, and an automatic volume control circuit connected to at least one of the rectifiers for regulating the signal transmission through said receiver.

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