

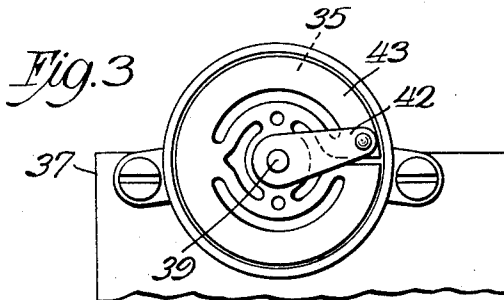
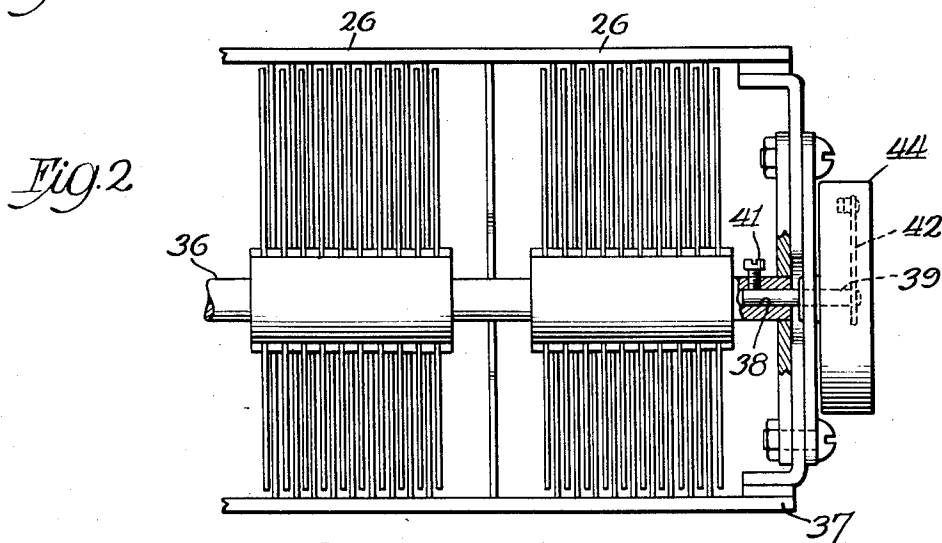
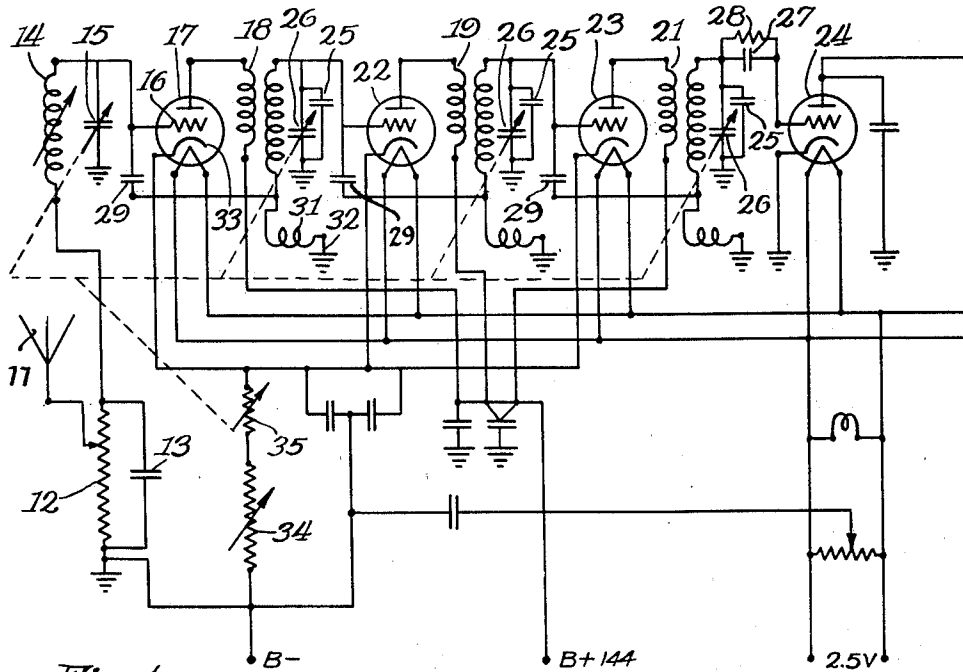
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# RADIO RECEIVING APPARATUS

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## UNITED STATES PATENT OFFICE

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## RADIO RECEIVING APPARATUS

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7 Claims. (Cl. 179—171)

This invention relates to a radio receiving apparatus and more particularly to means for maintaining uniform sensitivity in a radio receiver in the reception of waves of different frequencies.

In a reception of radio frequency waves, it is found that the radio frequency transformers do not uniformly step up the voltages for the different frequencies, due chiefly to the following two things: First, the magnetic coupling at the higher frequencies is greater than at the lower frequencies. Second, the L/C ratio becomes greater at the high frequencies than at the low frequencies. These facts are particularly disturbing in tuned radio frequency amplifiers, because in order to get enough amplification at the low frequencies, several stages are necessary. This, then, is accompanied by an extremely high amplification at the high frequencies, which, for a number of reasons, becomes almost uncontrollable, even in a well shielded receiver. If, therefore, the receiving set has its sensitivity automatically adjusted, as the main tuning control is turned, the receiver can be made to show equal, or almost any degree of sensitivity over the entire frequency band, and also be exceptionally free from regeneration because of the reduction of the extreme amplification at the high frequencies.

An object of the invention is to provide an improved radio receiving apparatus.

A further object is to provide a radio receiving apparatus having a uniform or predetermined sensitivity for different frequencies.

A further object is to provide an apparatus for automatically adjusting the sensitivity of a radio receiver in accordance with the frequency to which the receiver is adjusted.

A further object is to provide an apparatus for varying the plate circuit resistance in accordance with the frequency to which the receiver is adjusted.

A further object is to provide an apparatus for controlling the output circuit of an audion in a tuned radio frequency circuit in accordance with the condenser setting of the input circuit.

A further object is to provide an apparatus for varying the grid bias in accordance with the frequency for which the apparatus is in resonance.

Referring to the drawing:

Fig. 1 is a diagrammatic view of a radio receiver embodying the invention;

Fig. 2 is a fragmentary plan view of the gang condenser of the apparatus showing the bias con-

trolling resistance mounted upon the end of the condenser shaft, and

Fig. 3 is an end view of the variable resistance element for the bias control.

In the drawing an antenna 11 is shown leading to a variable resistance or potentiometer 12 upon which the incoming signals are impressed. The potentiometer is shunted by a condenser 13 forming a capacitative coupling between the resonant input circuit comprising a variable inductance 14 and a variable condenser 15. The signals from this circuit are impressed upon the grid 16 of a thermionic relay 17 of the hot cathode type. The radio frequency signals are successively transferred to radio frequency transformers 18, 19 and 21 which are connected in cascade to thermionic relays 22, 23 and 24, each transformer having a fixed condenser 25 and a variable condenser 26 across its secondary winding. Relay 24 serves as a detector and is provided with a grid condenser 27 and leak resistance 28.

In order to control the feed back or regeneration, a degenerating condenser 29 is connected between the grid of each relay and one end of the secondary winding of the radio frequency transformer in the output circuit of the relay. A potential varying oppositely to the grid potential is impressed upon the condenser 29 by a reactance coil 31 which is connected to the end of the secondary winding of the transformer and leads to ground 32.

The degree of amplification of the circuit may be regulated by placing the variable resistance 34 between cathodes 33 and the negative side of the B battery supply. The effect of this resistance is to render the cathodes positive with respect to the grids, producing a negative bias upon the grids. An additional effect of this resistance is to change the internal plate impedance of the tube, thereby changing the sensitivity of each individual stage, and likewise the over-all sensitivity of the receiver. It also adds resistance to the plate circuits of the tubes and reduces the potential of the B supply. The variable resistance 34 may be omitted and the volume may be controlled wholly by the potentiometer 12.

An auxiliary control resistance 35 is provided between the main volume control resistance 34 and the cathodes, or in case the main volume control resistance is omitted, the auxiliary resistance is connected directly to the negative side of the B supply.

All of the variable condensers 15 and 26 are mounted upon a single shaft 36, which is mounted in a frame 37. The end of the shaft 36 is pro-

vided with a bore 38 into which a stub shaft 39 is inserted and held in place by a set screw 41. The stub shaft 39 carries an arm 42 and serves to engage a flexible element 43 with a resistance element 35 to place varying portions of the resistance in the circuit between the cathodes and the B supply as the arm is rotated. The resistance element is supported in an insulating cup 44 which is stationarily mounted upon the frame 37.

Thus as the position of condensers 15 and 26 is changed to tune the receiver to receive different frequencies the resistance will automatically be changed. For high frequencies a large amount of resistance will be placed in the circuit making the grids more negative with respect to the cathodes and for low frequencies the resistance will be decreased. The value of the resistance is so chosen that the transformer will have a substantially flat characteristic curve of amplification for different frequencies indicating that the degree of amplification for all frequencies is substantially uniform. Since the degeneration produced by condensers 29 and coils 31 varies for different degrees of amplification it will be seen that if the apparatus is adjusted to produce the proper amount of degeneration at one frequency to render it stable this adjustment will not be disturbed when the apparatus is tuned to receive waves of a different frequency.

Due to the fact that the variable biasing resistance is mounted directly on the condenser shaft the adjustment takes place automatically without any attention on the part of the operator, making it possible for anyone to tune in the different stations without producing undesirable noises in the speaker even though they are inexperienced in operating the receiver.

In addition to the features and functions pointed out above, it is apparent that the apparatus may be adjusted to give almost any shape of frequency characteristic over the entire broadcast frequency band. This is accomplished by controlling the rate of change of resistance as the main tuning dial is turned.

It will be understood that the embodiment of the invention herein described is merely illustrative and that many other modifications may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What I claim as new and desire to protect by United States Letters Patent is:

1. In a radio receiver, a plurality of thermionic relays each having a grid circuit and a plate circuit, an electron emission element in each plate circuit, a condenser in each grid circuit for tuning the grid circuit, a shaft for actuating all of said condensers, means for negatively biasing said grids relative to said elements increasing the negative bias for high frequencies and decreasing the negative bias for low frequencies, said biasing means being mounted on the condenser shaft.

2. In a radio receiver, a plurality of thermionic relays each having a grid circuit and a plate circuit, an electron emission element in each plate circuit, a condenser in each grid circuit for tuning the grid circuit, a support for said condensers, a common shaft for varying the adjustment of said condensers to tune said circuits for various frequencies, a common resistance element for applying a negative grid bias to vary the grid bias of said relays, said resistance element being mounted upon the condenser support, an arm carried by said condenser shaft and operable to vary the resistance in accordance with the position of said shaft whereby the tuning of the grid circuit and the grid bias will have a predetermined relation.

3. In a receiving system, a thermionic relay having an anode, a grid, and a cathode, an anode circuit, a grid circuit, means for compensating for the interelectrode capacity of said relay to prevent feed-back of energy from the anode to the grid circuit, means for applying a positive potential to the cathode relative to the grid, and means for varying said positive potential to maintain uniform sensitivity in the system.

4. In a radio frequency amplifier having a vacuum tube provided with input and output circuits, means to tune at least one of said circuits to adjust the frequency response thereof, said circuit having a non-uniform transmission characteristic over its frequency operating range, volume control means for adjusting the amplification of said tube by varying the relative potentials of the cathode and control electrode of said tube, and means for adjusting said volume control means in response to the tuning adjustment whereby the over-all sensitivity of the amplifier at various frequencies is substantially constant.

5. In a radio frequency amplifier having a vacuum tube provided with input and output circuits, transformers in said circuits, tuning means for one of said circuits to adjust the frequency response, means for negatively biasing the control electrode with respect to the cathode of said tube, and means for changing said control electrode bias with said tuning adjustment so that as the resonance frequency is increased the sensitivity of the amplifier is decreased to compensate for the increased transmission characteristic of the circuits.

6. In a radio frequency amplifier having a vacuum tube provided with input and output circuits, tuning means in said input circuit for adjusting the frequency response, means for maintaining the potential of the cathode positive with respect to the control electrode, and means for varying said positive potential in accordance with the tuning adjustment so that the amplification of the tube is varied in a sense opposite to the variation in transmission characteristics of the input and output circuits whereby a uniform over-all sensitivity of the amplifier for varying frequencies is obtained.

7. The circuit of claim 4 in which the volume control means comprises a main volume control and an auxiliary volume control with the auxiliary control adjusted in response to tuning adjustments.

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