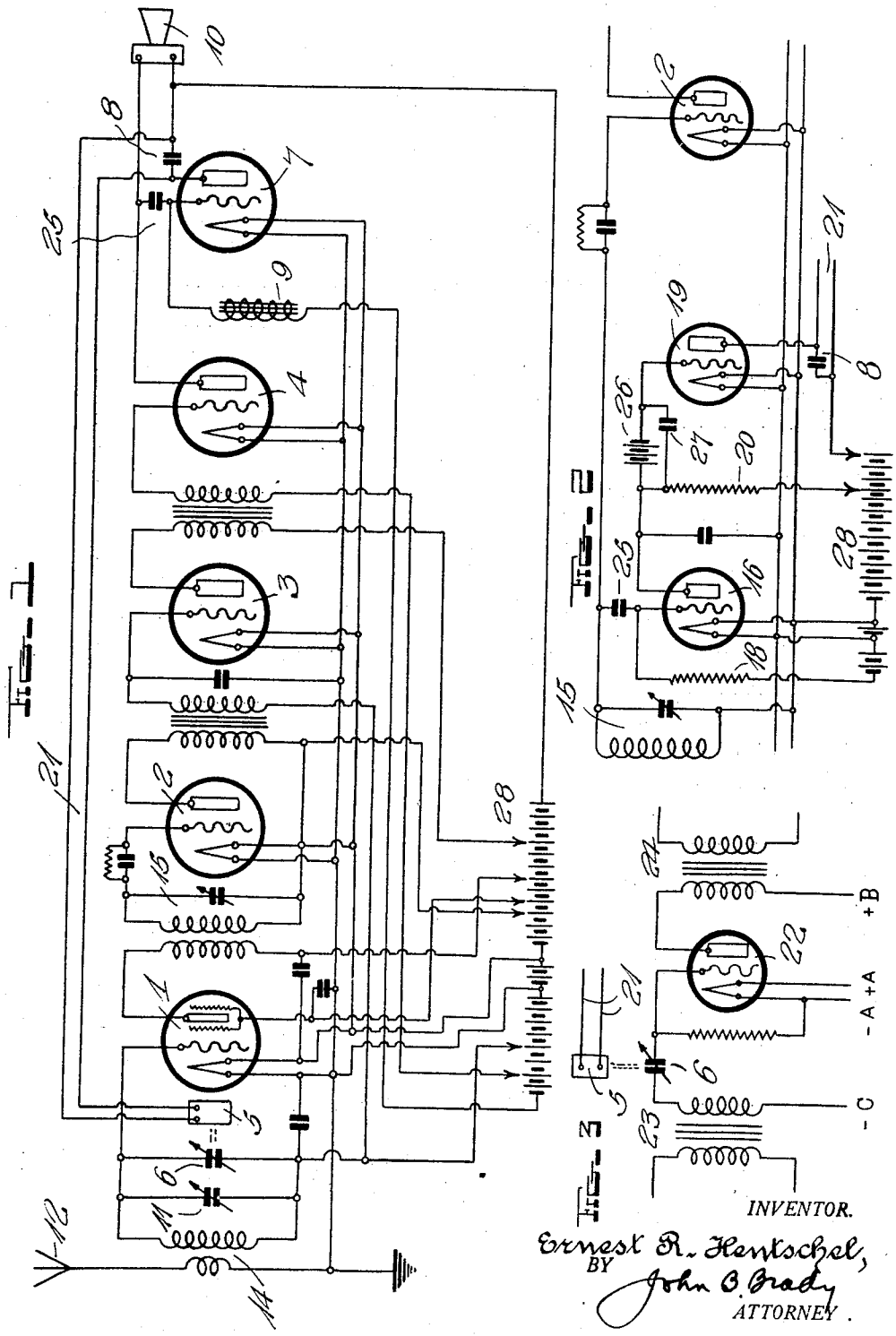
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VOLUME CONTROL SYSTEM FOR RADIORECEIVERS

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UNITED STATES PATENT OFFICE

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VOLUME CONTROL SYSTEM FOR RADIORECEIVERS

Application filed August 9, 1930. Serial No. 474,206.

My invention relates broadly to radio receiving circuits and more particularly to an automatic volume control circuit for radio receivers, whereby the volume of reproduced sound may be maintained substantially uniform independently of sudden increases in volume which occur due to fading effects at a receiver, when operating with respect to a distant broadcasting transmitter.

One of the objects of my invention is to provide a simplified form of volume control circuit, in which the output of the audio frequency amplifier is rectified and applied to a control device for effecting a detuning of the radio frequency amplification system in the receiver, whereby the amplitude of reproduced sound may be decreased in the event that the signaling energy tends to increase due to fading effects.

Another object of my invention is to provide a circuit arrangement for a volume control system in which a rectifier circuit operates in accordance with a predetermined signal level at the reproducer, and the energy thus derived utilized to actuate a detuning device in the radio frequency amplification system of the radio receiver for maintaining the volume of reproduced sound substantially uniform.

Still another object of my invention is to provide an arrangement of rectifier circuit adapted to be connected into a selected position in a radio broadcast receiving system, for developing control impulses for actuating a detuning mechanism and correspondingly controlling the selectivity of the radio receiving circuit according to the amplitude of reproduced sound whereby the sound reproduced by the receiver is maintained substantially constant independent of fading effects.

A further object of my invention is to provide a circuit arrangement for coupling a rectifying element into a broadcast receiver in such a position that energy may be derived for operating a detuning device, and maintaining the volume of reproduced sound substantially constant at the receiver independent of fading effects.

Other and further objects of my invention reside in the circuit arrangement for a rectifying element in a volume control circuit for a radio receiver as set forth more fully in the specification hereinafter following by reference to the accompanying drawing, in which:

Figure 1 diagrammatically illustrates a radio broadcast receiver showing the application of the volume control circuit of my invention thereto; Fig. 2 illustrates a modified form of control circuit for an amplification system connected according to my invention; and Fig. 3 illustrates a further modified form of frequency control device employed in the volume control system of my invention.

My invention is directed to a method for automatically operating a volume control device by means of direct current obtained by rectifying the alternating current of either audio or radio frequency, which varies according to the amplitude of the incoming signaling energy.

In Fig. 1, I have shown a radio receiver employing one stage of radio frequency, a detector and two stages of audio frequency. If desired, more stages may be used, and different types may be employed. The radio frequency amplifier has been designated at 1, the detector at 2, and the audio frequency amplifier at 3 and 4. Power supply for the several circuits has been designated generally at 28. Parts represented by numerals 5 and 6 constitute a light condenser operated by a direct current device. This device is shown in more detail in my copending application Serial No. 474,779 filed August 12, 1930, entitled "Volume control system for radio receivers". Numeral 7 refers to a rectifier using a direct current voltage on the plate and a highly biased grid, so as to block the tube with no excitation on the grid. 8 designates an audio frequency by-pass condenser, and 9 is an audio frequency choke. Condenser 25 serves as a coupling element for establishing a path between the plate of the amplifier 4 to the grid of rectifier tube 7.

When the volume of signal in the loud speaker 10 becomes high, and therefore, the audio frequency voltage across the speaker

also high, the pulsations, which are transmitted to the grid of rectifier tube 7, cause the plate current of this tube to increase. The plate current flows through part 5 of the device mentioned above, and rotates condenser 6. When the condenser is rotated, the tuned radio frequency circuit 11 of which it is a part is detuned, and the energy decreased, thus decreasing the output of the receiver. It is possible to choose a certain value of signal intensity at which this control begins to take effect by adjusting the bias on the grid of rectifier 7, so that the plate is blocked until this value is reached. The rotating part of condenser 6 is damped, so that it will take a definite time interval such as for example about one second for it to rotate sufficiently to cause a noticeable change in volme, in order that its motion will not follow ordinary variations in sound amplitude. This can be done by magnetic means, by one of the methods in which liquids flow through small openings, or by submerging the device in viscous oil.

Although the volume control condenser is shown in the circuit of the first tube 1, it could be placed in any radio frequency tube circuit, or in the antenna as described in my copending application Serial No. 474,779 filed August 12, 1930. In fact, it will give quicker action if placed elsewhere, because the antenna 12, being coupled to the first transformer 14, broadens the tuning somewhat. If the circuit tunes sharply, a small change in capacity of condenser 6 will give a greater increase in signal.

As described so far, the operation of the device depends on the amplitude of the audio frequency currents, and the amplitude of the carrier wave affects the control only insofar as the greater amplitude of the carrier wave brings in a greater amplitude of the audio frequency component. If it is desired to depend only on the amplitude of the radio frequency carrier, the rectifier may be connected as shown in Fig. 2, which shows the detector circuit only. This circuit is chosen because it has the most radio frequency energy as it is the last amplification stage. 2 is the detector tube and 15 its tuned circuit. 16 is a rectifier of the same type as shown at 7, in Fig. 1, except that a resistor 18 is used in place of a choke. 19 designates a direct current amplifier of the usual type having potential source 26 for biasing the grid of tube 19. Condenser 27 serves to by-pass pulsations passed by rectifier 16. When direct current flows through resistance 20, a greater change in current occurs in the plate of tube 19 and lines 21 which go to the operating part of the volume control device. This direct current amplifier is shown so as to indicate a method for obtaining more power. If the control device is light and has little friction, the extra amplification will not be needed.

A combination of radio frequency and audio frequency control is obtained by combining the two methods here shown. This may be done by putting two windings in the armature of the control device, and connecting one to each of the rectifiers described.

Although a radio receiver is shown, a modification of the first method disclosed has uses in other types of apparatus, such as public address microphone and amplifier systems, and in controlling the amplitude of audio frequency currents employed to modulate broadcast transmitters. In these applications, condenser 6 is placed in series with the grid of one of the amplifier tubes as shown at 22 in Fig. 3, so as to regulate the amount of energy fed to that tube. Tube 22 is shown as one stage of an implifier system where the input is coupled through transformer 23, and the output is coupled through transformer 24.

It is understood that other types of rectifiers may be used, and it may be possible to use this control device to operate other types of volume control apparatus.

In each of the control circuits, the output of the rectifier tube contains the condenser 8. The potential drop across condenser 8 is in reality the potential drop across the actuating winding of the volume control device which has been indicated en bloc, at 5. Direct current flows along the line 21 to control the actuating winding of the volume control device, while the alternating current component passes through condenser 8 in the output circuit of the rectifier tube in the arrangement shown in Fig. 1.

In the circuit of Fig. 2, there is a radio frequency component which is passed through condenser 8, while the direct current component flows along line 21 for the control of the actuating winding of the volume control device.

While I have described my invention in certain preferred embodiments, I desire that it be understood that modifications may be made and that no limitations upon my invention are intended other than are imposed by the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier connected to the output of said audio frequency amplifier, and means controlled by said auxiliary rectifier for effecting a detuning of said radio frequency amplifier when the volume of reproduced sound exceeds a predetermined signal level.

2. A radio broadcast receiving circuit including a radio frequency amplifier portion,

a detector connected therewith, an audio frequency amplifier portion connected with said detector, a radio frequency energy collecting circuit connected with said radio frequency amplifier portion, a sound reproducer connected with said audio frequency amplifier portion, an auxiliary rectifier connected to the output of said audio frequency amplifier portion, a variable capacity element connected with said radio frequency amplifier portion and a motor device for rotatably adjusting said variable capacity element controlled by the output of said auxiliary rectifier for controlling the amount of energy transferred from said radio frequency energy collecting circuit to said detector according to the amplitude of signaling energy in the output circuit of said audio frequency amplifier portion.

3. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier connected to the output of said audio frequency amplifier, and means actuated by said auxiliary rectifier for effecting a detuning of said radio frequency amplifier when the volume of reproduced sound exceeds a predetermined signal level, said auxiliary rectifier being biased to remain inoperative for all values of signal current below said predetermined signal level.

4. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier connected to the output of said audio frequency amplifier, and highly damped means responsive to changes in energy in the output circuit of said auxiliary rectifier for effecting a detuning of said radio frequency amplifier when the volume of the reproduced sound exceeds a predetermined signal level.

5. A radio broadcast receiving circuit including a radio frequency amplifier portion, a detector connected thereto, an audio frequency amplifier portion connected with said detector, a radio frequency energy collecting circuit connected with said radio frequency amplifier portion, a sound reproducer connected with said audio frequency amplifier portion, an auxiliary rectifier connected to the output of said audio frequency amplifier portion, and means including a variable impedance device connected in circuit with said radio frequency amplifier portion and controlled by the output of said auxiliary rectifier for controlling the amount of energy transferred from said radio frequency energy collecting circuit to said detector on a selected frequency according to the amplitude of signaling energy in the output circuit of said audio frequency amplifier portion.

6. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier, said auxiliary rectifier having its input terminals connected across the output terminals of said audio frequency amplifier and means controlled by the output circuit of said auxiliary rectifier for effecting a detuning of said radio frequency amplifier when the volume of reproduced sound exceeds a predetermined signal level.

7. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier, said auxiliary rectifier having its input terminals capacitively coupled with the output circuit of said audio frequency amplifier and means controlled by the output circuit of said auxiliary rectifier for effecting a detuning of said radio frequency amplifier when the volume of reproduced sound exceeds a predetermined signal level.

8. A radio broadcast receiver including a radio frequency amplifier, a detector, and an audio frequency amplifier, a radio frequency energy collecting circuit connected with said radio frequency amplifier, an auxiliary rectifier, said auxiliary rectifier having its input terminals capacitively coupled with the output of said audio frequency amplifier, means in the input circuit of the auxiliary rectifier for suppressing the passage of unrectified audio frequency current through the auxiliary rectifier and means controlled by the output circuit of said auxiliary rectifier for effecting a detuning of said radio frequency ampilfier when the volume of reproduced sound exceeds a predetermined signal level.

In testimony whereof I affix my signature.

ERNEST R. HENTSCHEL.