Aug. 12, 1930. R. S. OHL 1,772,517

RADIO RECEIVER

Filed Feb. 20, 1926

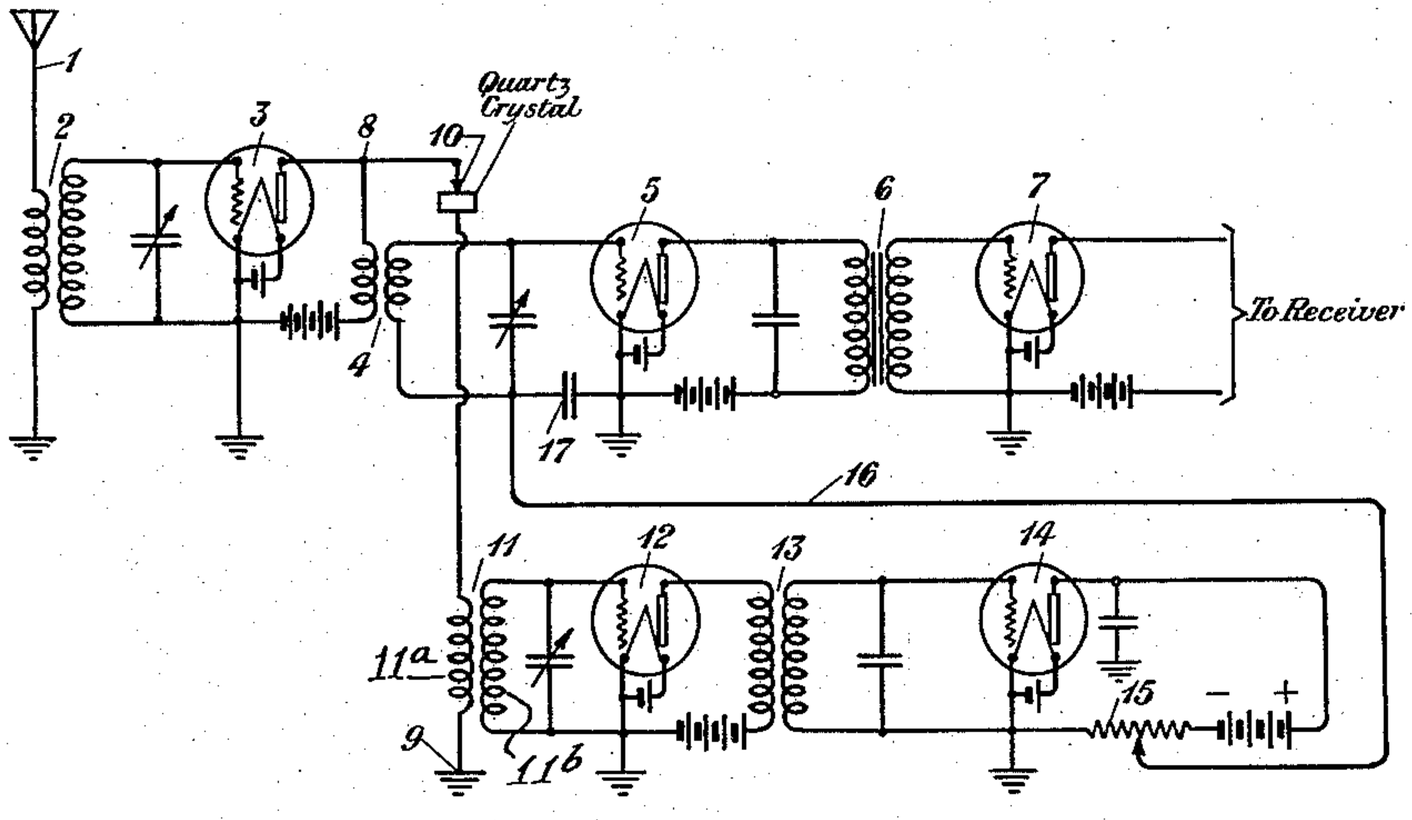

Fig. 1

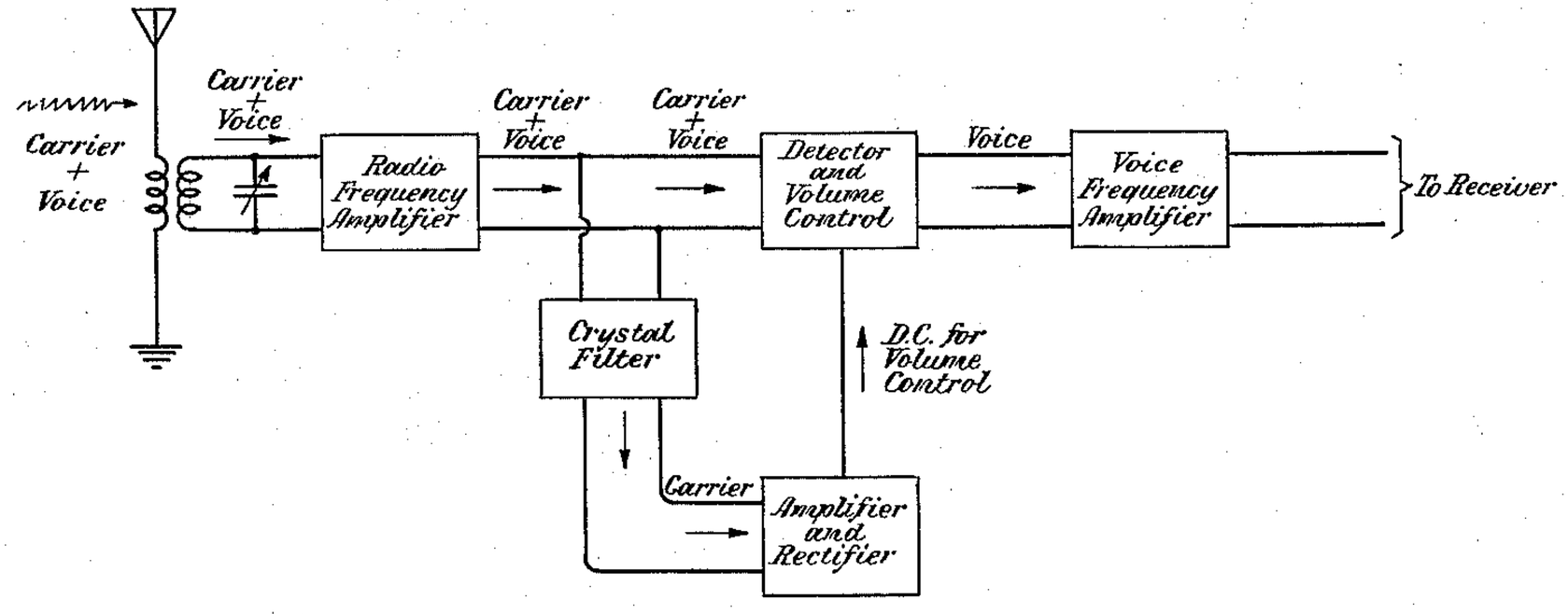

Fig. 2

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UNITED STATES PATENT OFFICE

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RADIORECEIVER

Application filed February 20, 1926. Serial No. 89,794.

This invention relates to radio receiving systems, and more particularly to methods of and means for controlling the output volume of the receiver.

In the radio receiving system disclosed in the United States patent to Affel, No. 1,511,015, October 7, 1924, there is shown an arrangement for controlling the output volume of the receiver whereby a portion of the energy in the receiving channel is taken off after it has been passed through the detector and an amplifier and is then utilized to effect volume control in accordance with the fluctuations of the carrier intensity, the energy in the branch path being rectified and fed back to the grid of the detector to adjust the biasing potential thereon and thus to control the gain. With such an arrangement there is the likelihood of singing in the system.

It is applicant's object to provide for the automatic maintenance of the output volume level in spite of variations of the carrier intensity, and further, to accomplish this without the danger of singing in the receiving system.

Applicant also aims to provide a more reliable control of the output volume, and with this aim in view utilizes means new in this connection for selecting more sharply than has been done heretofore the carrier frequency component which is to be rectified and impressed upon the detector to effect the desired variation of grid potential.

Applicant accomplishes his purpose by providing a branch path from the receiving channel at a point in the system ahead of the detector, for instance from the output circuit of the radio frequency amplifier; placing in this branch path a quartz crystal which filters out the voice side-bands; amplifying the carrier current; rectifying the carrier energy, and causing variations of the carrier intensity automatically to produce offsetting variations of the negative biasing voltage on the grid of the detector, whereby the output volume of the detector is maintained substantially constant.

Applicant's invention not only overcomes fading due to variations of the carrier intensity, as does Affel's, but it overcomes fading without any likelihood of singing in the system, and by virtue of this feature of applicant's arrangement, there is provided compensation for a greater variation of carrier amplitude. These and other advantages of the invention will appear more clearly hereinafter.

Applicant's invention will be more clearly understood when the following detailed description is read with reference to the accompanying drawing. Figure 1 of the drawing shows diagrammatically the circuit arrangements of the receiving system, including the circuit means for effecting the volume control; Fig. 2 shows schematically the flow in the system of the various currents, including the direct current for the volume-control.

With reference to the details of Fig. 1, the antenna 1, the transformer 2, the vacuum tube radio frequency amplifier 3, the transformer 4, the vacuum tube detector 5, the transformer 6, and the vacuum tube voice frequency amplifier 7 are elements ordinarily found in radio receiving systems.

From the point 8 in the plate circuit of the radio frequency amplifier 3, applicant provides a lead to ground at 9, and places in this branch path of the amplifier output a quartz crystal 10 and the primary winding 11^a of the transformer 11. The secondary winding 11^b of the transformer 11 serves as the input to the vacuum tube amplifier 12, which is inductively connected through the transformer 13 to the vacuum tube 14. In the plate circuit of the tube 14 is placed a resistance 15, from which a wire 16 leads to the grid circuit of the detector tube 5.

The operation of applicant's system will now be described, reference being had to Fig. 1 for a diagrammatic showing of the apparatus involved, and to Fig. 2 for a schematic showing of the current flow in the system. The incoming radio signals are amplified in the tube 3. There are two possible channels in the output circuit of this amplifier, the one into the detector 5 and the other through the quartz crystal 10 into the amplifier 12. The resonance properties of the quartz crystal are dividedly marked. The device serves as a filter, beginning to cut off frequencies ten

cycles to either side of the carrier, and frequencies of approximately sixty cycles to either side of the carrier are greatly attenuated. Consequently, the crystal serves to filter out the voice side-band frequencies and to pass the carrier frequency. In accordance with applicant's arrangement, the carrier current output of the crystal filter 10 is amplified in the tube 12, and the carrier energy is then rectified—or translated into one-way energy—in the tube 14. The flow of pulsating current through the resistance 15 in the plate circuit of the tube 14 reacts on the detector 5 by virtue of the circuit arrangement shown and described above. More specifically, variations of the carrier intensity cause responsive variations in the amount of negative biasing on the grid of the detector tube 5, because of the voltage drop in the resistance 15, in the plate circuit of the tube 14. Thus, when the carrier intensity increases, there is automatically produced an increase of the negative voltage on the grid of the tube 5 because of the increase of plate current in the tube 14, and, as is well understood in the art, this increased negative voltage serves to reduce the current flow in the plate circuit of the detector tube. Consequently, the output level of the detector is lowered. Conversely, a decrease of carrier intensity automatically produces a decrease of the negative voltage on the detector grid and an increase of the detector output volume. It follows of course that this control of the output level of detector tube 5 likewise controls the speech input to the voice frequency amplifier 7.

While applicant's invention has been disclosed in one specific embodiment which is deemed desirable, it is to be understood that it is capable of embodiment in many other and different forms within the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. In a radio receiving system, a three-electrode vacuum tube detector, means included in the system ahead of the detector for drawing off a part of the carrier frequency and the voice side-band frequencies combined and for separating the carrier frequency from the voice side-band frequencies, and means for controlling the biasing voltage on the grid of the detector in response to and as an offset to variations of the carrier intensity.

2. In a radio receiving system, a three-electrode vacuum tube detector, means ahead of the detector for passing a part of the carrier frequency and the voice side-band frequencies combined into a branch path, means for passing the balance of the carrier frequency and voice side-band frequencies combined to the input of the detector. means in said branch path for filtering out the voice side-band frequencies, means for rectifying the carrier energy, and means responsive to the current flowing in the output of said rectifying means for controlling the biasing voltage on the grid of the detector.

3. In a radio receiving system, a detector and a circuit arrangement for maintaining substantially level the output volume of said detector, said arrangement comprising means ahead of the detector for drawing off a part of the carrier frequency and the voice side band frequencies combined and for separating the carrier frequency from the voice side-band frequencies, means for rectifying the carrier energy, and means for controlling the output volume of the detector by offsetting therein variations of the carrier intensity.

4. In a radio receiving system including a three-electrode vacuum tube detector, the method of controlling the output volume of the detector which consists in passing a part of the carrier frequency and the voice side-band frequencies combined into a branch path before detection, passing the balance of the carrier frequency and the voice side-band frequencies combined to the input of the detector, filtering out in said branch path the voice side-band frequencies, rectifying the carrier energy, and causing variations of the carrier intensity to produce offsetting variations of the biasing voltage on the grid of the detector.

5. In a radio receiving system, a main path, a detector in said main path, a path branching from the main path at a point ahead of the detector, a quartz crystal filter in the branch path for eliminating from said branch path the voice side-band frequencies and passing the carrier frequency, means for rectifying the carrier energy, and means responsive to the current flowing in the output of said rectifying means for controlling the output volume of the detector.

6. In a radio receiving system, a main path, a three-electrode vacuum tube detector in said main path, a path branching from the main path at a point ahead of the detector, a quartz crystal filter in the branch path for eliminating from said branch path the voice side-band frequencies and passing the carrier frequency, means for rectifying the carrier energy, and means for increasing and decreasing the negative biasing voltage on the grid of the detector in response to increases and decreases, respectively, of the current in the output of said rectifying means.

In testimony whereof, I have signed my name to this specification this 18th day of February, 1926.

RUSSELL S. OHL.