June 6, 1939. J. L. DELVAUX 2,161,286

CONTROL FOR A SIGNALING SYSTEM

Filed Oct. 27, 1937

Fig. 1.

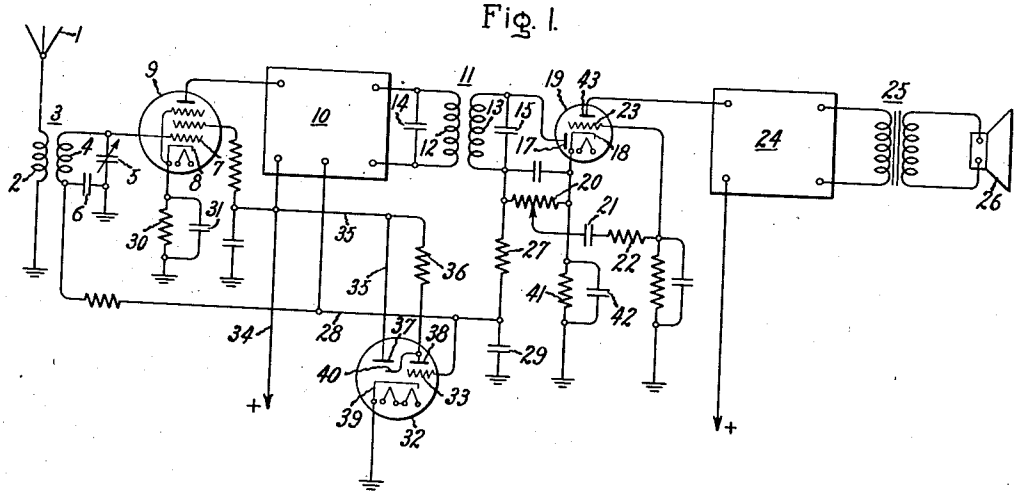
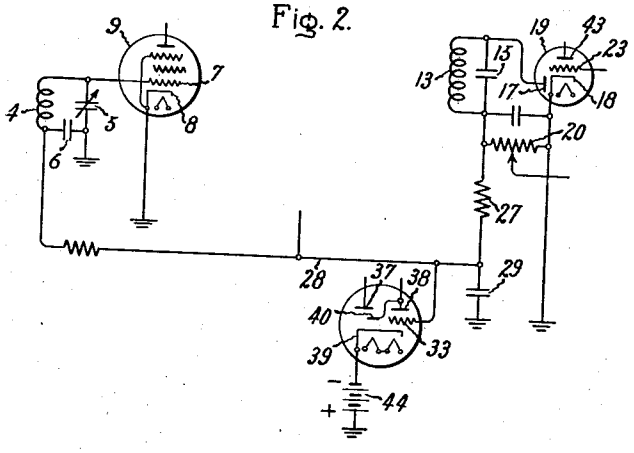


Fig. 2.



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Patented June 6, 1939 2,161,286

UNITED STATES PATENT OFFICE

2,161,286

CONTROL FOR A SIGNALING SYSTEM

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Application October 27, 1937, Serial No. 171,294
In France January 21, 1937

8 Claims. (Cl. 250—20)

My invention relates to an improved control for a signaling system and more particularly to an improved control for regulating the gain of a signal amplifier. In greater particularity, my invention relates to an improved arrangement for limiting the response of an automatic volume control to those signals having at least a predetermined amplitude of oscillation.

An object of my invention is to provide in a radio receiver an automatic volume control of the delayed type which secures its delayed characteristic from the operation of an electron discharge device.

A further object of my invention is to accomplish a delayed operation of an automatic volume control by utilizing an electron discharge device normally present and performing a particular function in a signaling system separate and distinct from that of automatic volume control.

A still further object of my invention is to utilize an electron discharge device having a plurality of elements connected to perform a particular function in a signaling system, and to secure from two of the elements the additional function of providing a delay operation in an automatic volume control arrangement.

Another object of my invention is to provide a delayed automatic volume control arrangement which uses a minimum number of electron discharge devices and has the additional advantages of simplicity of construction and reliability of operation.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents an embodiment of my invention and Fig. 2 represents a modification thereof.

Referring to Fig. 1 of the drawing, I have illustrated my invention as embodied in a radio receiver having an antenna 1 connected to ground through the primary 2 of a radio frequency transformer 3, the transformer having a secondary winding 4 tuned to a desired signal frequency by a variable condenser 5 connected in series with a fixed condenser 6. Signal oscillations appearing across this tuned circuit are impressed upon the grid 7 and the cathode 8 of an electron discharge signal amplifier 9. The signal oscillations are amplified by the signal amplifier 9 and pass to additional signal amplifiers represented conventionally as 10 which may comprise any desired number of stages of amplification and may possibly include a converter arrangement for converting and thereafter amplifying the signal oscillation at a frequency different from that of the original signal frequency. The signal oscillations thereafter pass through a transformer 11 having a primary winding 12 and a secondary winding 13 tuned by the respective condensers 14 and 15 to the frequency of the signal oscillation, which may be either the initial frequency or the converted frequency where a converter arrangement is used, and are rectified by the diode elements 17 and 18 of a multi-element electron discharge device 19. The audio frequency component of the rectified signal oscillation appears as a pulsating unidirectional electromotive force across a potentiometer 20. A portion of this electromotive force is transferred through a condenser 21 and a resistor 22 to a grid 23 of the discharge device 19 where it is amplified and passes to an audio frequency amplifier conventionally represented as 24 which may comprise any desired number of stages of amplification. The electromotive force as thus amplified passes through an output transformer 25 for reproduction by a reproducer 26.

The electromotive force appearing across the potentiometer 20 is also connected through a filter comprising a resistor 27 and a condenser 29 to a conventional automatic volume control circuit 28 connected to bias the grid 7 of the signal amplifier 9 and the corresponding grid of such other stages of the amplifier 10 as may be desired. The grid 7 of the signal amplifier 9 is given a small negative bias which may, for example, be obtained by the use of a resistor 30 and a parallel connected condenser 31 connected between the cathode 8 and ground. The corresponding grid of each amplifier stage 10 to which the automatic volume control potential is connected is biased with a negative potential in a similar manner to that of the grid 7. The operation of the automatic volume control arrangement thus far described is conventional and will not be further amplified since it is well understood in the art.

An indicator arrangement, for indicating that the receiver is tuned to the frequency of a received signal oscillation, is provided by an electron discharge device 32, commonly known as an electron-ray tube but more popularly known as a "Magic eye" tube. The construction of this tube is shown and its operation explained in the United States Patent to Wagner No. 2,051,189.

The control grid 33 of this device is connected to the automatic volume control circuit 28. A high positive potential is supplied through the conductors 34 and 35 to the fluorescent anode 37 and through a resistor 36 to the anode 38 of the discharge device 32, the cathode 39 being grounded. The cathode 39, the grid 33, and the anode 38 of the discharge device 32 operate as a direct current amplifier of the control potential appearing in the automatic volume control circuit 28. An extension 40 of the anode 38 acts as a ray-control electrode and causes a shadow to appear on the fluorescent surface of the anode 37 having a width proportional to the potential of the anode 38 which in turn is dependent upon the potential of the control circuit 28. The discharge device 32 thus constitutes an arrangement for indicating by the relative width of a shadow on the fluorescent anode 37 that the receiver is tuned to the frequency of a received signal oscillation.

In accordance with my invention, I provide a delayed operation of the automatic volume control by utilizing the grid 33 and the cathode 39 of the electron discharge device 32 in an arrangement which, in the absence of a signal oscillation, maintains the diode anode 17 at a small negative potential with respect to the diode cathode 18. To this end, a resistor 41 and a parallel connected condenser 42 are connected between the cathode 18 of the discharge device 19 and ground. Space current in the discharge device 19 flowing from the anode 43 to the cathode 18 passes through the resistor 41 and causes the cathode 18 to have a positive potential with respect to ground. This positive potential is impressed through the resistors 20 and 27 upon the grid 33 of the electron discharge device 32 and, assuming the absence of a signal oscillation, the grid is thereby made positive with respect to the cathode 39 which is at ground potential. A current thereupon flows between the grid 33 and the cathode 39 to produce a potential drop in the resistor 20 of a polarity such that the diode anode 17 is maintained slightly negative relative to the diode cathode 18. It may be noted at this point that as long as current flows from the grid 33 to the cathode 39, the automatic volume control circuit 28 remains at approximately ground potential and the bias on the grid 7 of the signal amplifier 9 has a value equal to the potential drop across the resistor 30.

This negative condition of the diode anode 17 is maintained until a signal having a predetermined amplitude of oscillation drives the anode 17 positive with respect to the diode cathode 18 at which time the diode elements 17 and 18 begin to rectify the signal oscillations to cause a potential drop across the resistor 20 of a polarity tending to make the grid 33 of the discharge device 32 less positive. Current continues to flow between the grid 33 and the cathode 39 of the discharge device 32, however, until the amplitude of the signal oscillation appearing across the condenser 15 is sufficient to drive the grid 33 negative with respect to the cathode 39. When this occurs, a potential drop no longer exists across the resistors 20 and 27 caused by current flow between the grid 33 and the cathode 39 of the discharge device 32 and any increase in the electromotive force appearing across the resistor 20 is now effective as a control potential in the automatic volume control circuit 28 which ceased to be at ground potential when current ceased to flow between the grid 33 and the cathode 39 of the discharge device 32.

If the amplitude of the signal oscillation again decreases to a point where the grid 33 of the device 32 becomes slightly positive, current again flows from the grid 33 to the cathode 39 to cause a potential drop in the resistor 20 tending to drive the diode anode 17 negative with respect to the diode cathode 18. And as before, current continues to flow from the grid 33 to the cathode 39, and the automatic volume control circuit 28 continues to be at approximately ground potential, until such time as the amplitude of the signal oscillation increases to the predetermined value necessary to drive the grid 33 negative. Thereafter the automatic volume control circuit 28 is effective to vary the gain of the signal amplifier 9.

I have shown in Fig. 2 a modification of my invention whereby the biasing resistor 41 and condenser 42, which are connected in the cathode to ground circuit of the discharge device 19, and the biasing resistor 30 and condenser 31, connected in the cathode to ground circuit of the signal amplifier 9, may be eliminated and the cathodes 8 and 18 connected directly to ground. In this figure, elements corresponding to like elements of Fig. 1 are given like reference characters. A battery 44 is connected between the cathode 39 of the electron discharge device 32 and ground. In the absence of a signal oscillation, the battery 44 maintains the control circuit 28 and thereby the grid 7 of the signal amplifier 9 at a small negative potential with respect to ground and produces a current flow in a circuit comprising the resistors 20 and 27, the grid 33, and the cathode 39 of the discharge device 32 sufficient to impress a small negative potential on the diode anode 17 with respect to the diode cathode 18 of the discharge device 19. A signal having the required amplitude of oscillation produces a potential drop across the resistor 20 sufficient to drive the grid 33 of the discharge device 32 negative with respect to the cathode 39 after which any additional potential drop across the resistor 20 is effective in the automatic volume control circuit 28 to vary the gain of the signal amplifier 9.

While I have illustrated my invention by the use of an electron-ray type of electron discharge device, it will be obvious that any similar electron discharge device may be used which performs a similar function, or even a function totally unrelated to tuning indication, as long as two elements of the discharge device operate in the absence of a signal oscillation with a substantially zero potential difference relative one to another. It will further be obvious that the automatic control may be that for an audio frequency amplifier as well as for the radio frequency amplifier with which my invention is here shown and described.

While I have shown a specific embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto since many modifications may be made in the arrangement of the system and in the instrumentalities employed, and I therefore contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. The combination, in a tunable radio receiver, of an electron discharge signal amplifier having

a variable gain characteristic, control means responsive to received signal oscillations for varying the gain of said signal amplifier in substantially inverse proportion to the strength of said signal oscillations, means responsive to said control means and including an electron discharge device having a control grid and a cathode for indicating that said receiver is tuned to resonance with the frequency of said signal oscillations, and means including the grid to cathode path of said discharge device for delaying the application of control to said signal amplifier by said control means until said signal oscillations have a predetermined minimum strength.

2. The combination, in a radio receiver, of a variable gain electron discharge signal amplifier, control means for varying the gain of said amplifier in substantially inverse proportion to the strength of received signal oscillations, an electron discharge amplifier having elements including a grid, an anode and a cathode, means for supplying to the input circuit of said last named amplifier a potential to be amplified, means associated with the output circuit of said last named amplifier for utilizing amplified potentials, and means including the grid to cathode path of said last named amplifier for terminating the operation of said control means whenever said signal oscillations reach a predetermined strength.

3. The combination, in a signaling system, of an electron discharge signal amplifier having a variable gain characteristic, means to vary the gain of said amplifier in substantially inverse proportion to the average amplitude of signal oscillations, an electron discharge direct current amplifier having elements including a control grid, an anode and a cathode, means for supplying to the input circuit of said last named amplifier a unidirectional potential to be amplified, means associated with the output circuit of said last named amplifier for utilizing amplifier unidirectional potentials, and means including the control grid and cathode of said last-named amplifier for terminating the control of said first named means whenever the amplitude of said signal oscillations falls below a predetermined value.

4. In a signaling system, an electron discharge modulated-carrier signal amplifier, control means for varying the amplification of said amplifier in substantially inverse proportion to the average carrier amplitude of signal oscillations, an electron discharge device having an anode, a grid, and a cathode, translating means connected to said anode and to said cathode and operatively responsive only to negative values of biasing potential on said grid, and means connected to said grid and to said cathode and responsive only to positive values of biasing potential on said grid for terminating the operation of said control means whenever the amplitude of said signal oscillations acquires a predetermined value.

5. In combination, an electron discharge signal amplifier having a control grid, means responsive to the amplitude of signal oscillations for biasing said control grid, an electron discharge device having a control grid connected to be influenced by said means and having an anode and a cathode, translating means connected to said anode and to said cathode, and means for terminating the response of said first named means whenever said signal oscillations fall below a predetermined amplitude, said last named means including means to impress a positive potential on the control grid of said last named discharge device in the absence of a signal oscillation.

6. The combination, in a signaling system, of a radio frequency amplifier having a variable gain characteristic, means including an impedance for developing a control potential from signal oscillations, means utilizing said control potential for varying the gain of said amplifier, an electron discharge amplifier having an anode, a cathode, and a control grid, means utilizing said control potential for biasing said control grid, and means including said impedance for giving said control grid a positive bias in the absence of signal oscillations whereby the development of said control potential by said first named means is delayed until said signal oscillations have a predetermined amplitude.

7. A delayed automatic volume control for a signaling apparatus comprising, in combination, a source of signal oscillations, a variable gain electrode discharge signal amplifier connected to said source and having an output circuit, means associated with said output circuit and including an impedance for developing a control potential from signal oscillations appearing therein, means utilizing said control potential to vary the gain of said signal amplifier, an electron discharge device having elements including a grid and a cathode, said grid and said cathode being connected to said output circuit, and a source of potential connected in a circuit including in series said grid, said cathode and said impedance for maintaining the gain of said signal amplifier constant whenever the amplitude of said signal oscillations fall below a predetermined value.

8. An electron discharge signal amplifier having a variable gain characteristic, automatic volume control means including an impedance for regulating the gain of said amplifier, means responsive to signal oscillations for developing across said impedance a control potential, indicating means including an electron discharge device having a grid and a cathode for indicating the presence of signal oscillations, and means including a source of substantially constant electromotive force connected in a circuit comprising said impedance, said grid and said cathode for developing across said impedance a control potential of opposite polarity to that of said first named control potential whereby said second named means remains unresponsive to signal oscillations having an amplitude lower than a predetermined value.

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