

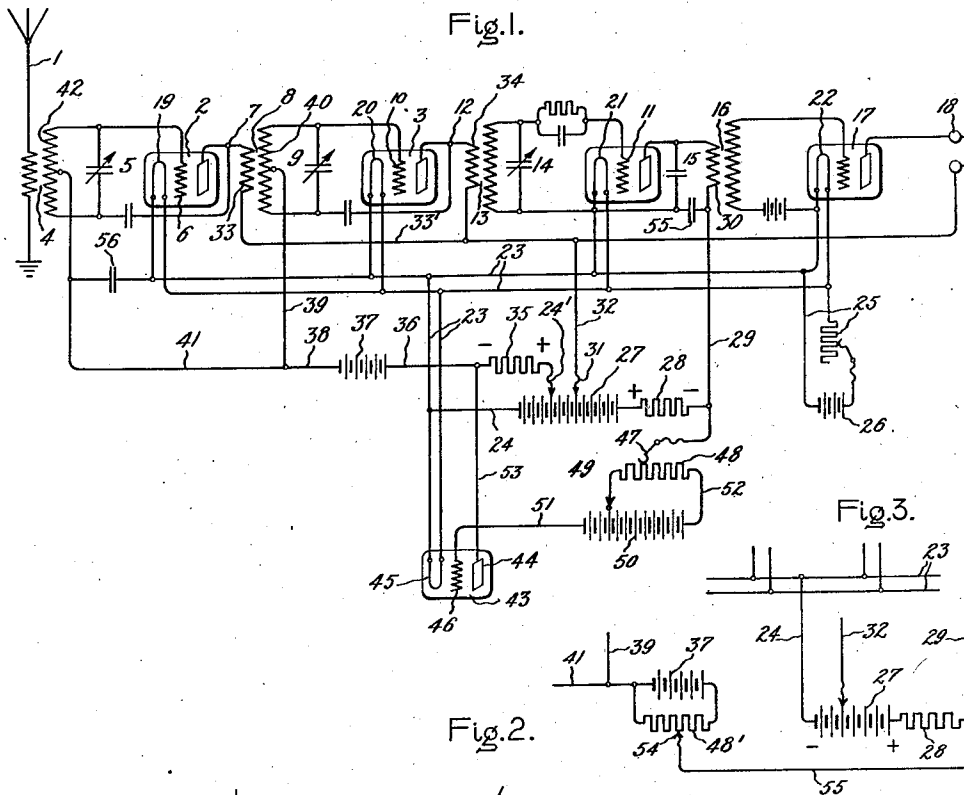
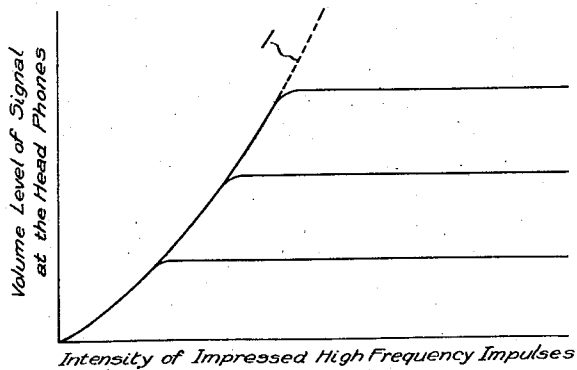
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SIGNALING SYSTEM

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SIGNALING SYSTEM

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My invention relates to signaling systems and particularly to systems for the reception of high frequency signaling currents, and has for its purpose to provide a signaling system such that the intensity of the received signal will be automatically maintained at or below a predetermined level.

It is well known that when the receiving circuits of a high frequency signaling system have been adjusted to produce great enough amplification for reception of signals from a distant station the signals from a near by station will be received in much greater volume than is desired. Likewise, it may result that during reception from a single station the transmission characteristics of the media over which the signals are being transmitted may vary causing the intensity of the received signals to fluctuate thereby necessitating frequent readjustment of the receiving circuit to compensate for the variations in the transmission media and to maintain the desired volume level of the received signal.

Means have heretofore been provided for automatically controlling the transmission level in high frequency systems. These means have usually involved relays which operate responsively to the intensity of the received high frequency impulses to control the power circuit to a motor which affects appropriate adjustments in the transmission circuit. Others have involved relays which operate responsively to the intensity of pilot frequencies transmitted over the same transmission media as the signal, while still others have involved relays which operate responsively to changes in current passed through pilot wires which are subjected to the same transmission conditions as the media over which the desired signal is being transmitted. Still other means have been provided for manually controlling the transmission level.

All of these systems have inherent disadvantages in that they either require the presence of a skilled operator or are complicated in their circuit construction necessitating the use of auxiliary carrier current generators, pilot wires and the like. Furthermore, the use of relays, motors and other instru-

mentalities having moving parts introduce disturbances and time delay in the operation of the system which in turn result in undesirable effects upon the receiver.

The purpose of my invention is to provide an apparatus of the type mentioned, which will be entirely automatic in its operation; and which will be simple in its circuit construction and entirely electrical in its operation. By the provision of such an apparatus I have found that the disadvantage of previous apparatus referred to above may be largely eliminated.

By my invention I vary the degree of amplification of the signaling circuit in direct electrical response to the intensity of the high frequency impulses which are impressed upon the system.

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 will best be understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 illustrates diagrammatically one form of my invention; Fig. 2 presents curves illustrating its operation; and in which Fig. 3 illustrates a modification of the circuit shown in Fig. 1.

With reference to Fig. 1, 1 illustrates a circuit leading to the usual antenna or wire line depending upon the particular application for which the system is employed. 2 and 3 represent the usual radio frequency amplifiers of the receiving circuit, amplifier 2 being supplied with energy from the input transformer 4 and input circuit 5 which is connected to the control electrode or grid 6 of the amplifier 2. Likewise, energy is supplied from the output circuit 7 of the electron discharge device 2 through the transformer 8, and tuned circuit 9 to the control electrode or grid 10 of the amplifier 3. 11 represents the detector of the usual receiving circuit. This detector receives its energy from the output circuit 12 of the amplifier 3 through the transformer 13 and input circuit 14. Audio frequency currents from the detector are supplied from the output circuit 15 through

transformer 16 to the audio amplifier 17 where they are amplified and impressed upon the head phones 18. While the amplifiers 2 and 3 and the detector 11 are shown as of the electron discharge type, it will be apparent that any type of amplifier or detector may be used. Since the circuit connections of the amplifiers and detector, as thus far described are merely those of a common receiving circuit, only so much detail is given as is necessary to an understanding of my invention. The cathodes 19, 20, 21 and 22 of the radio amplifiers 2 and 3, detector 11 and audio amplifier 17 are shown connected to a circuit 23 which is energized through resistance 25 from a suitable source of potential 26. Suitable high potential is supplied to the output circuit of the detector 11 from the high potential source 27 through a circuit as follows: cathode 21, cathode conductors 23, conductor 24, source of potential 27, resistance 28, conductor 29, primary winding 30 of the transformer 16 to the anode of the detector 11. The source of potential 27 which comprises the usual B battery of a receiving circuit is provided with an adjustable tap 31 from which a suitable potential may be supplied through conductor 32 and conductor 33' to the anode of the amplifier 2 through the primary winding 33 of the transformer 8, to the anode of the amplifier 3 through the primary winding 34 of the transformer 13 and to the anode of the amplifier 17 through the head phones 18. Likewise, a suitable source of potential is impressed upon the control circuits of the amplifiers 2 and 3 with respect to their cathodes 19 and 20 through a circuit as follows: cathode conductors 23, conductor 24, that portion of the source of potential 27 which is between the conductor 24 and the adjustable tap 24', adjustable tap 24', resistance 35, conductor 36, source of potential 37, conductor 38, thence through conductor 39, and a portion 40 of the secondary winding of the transformer 8 to the control electrode 10 of the amplifier 3, and through the conductor 41 and a portion 42 of the secondary winding of the transformer 4 to the control element 6 of the amplifier 2. It will be seen that the source of potential 37 is in series with that portion of the source of potential 27 which is between the conductor 24 and the adjustable tap 24'. Hence the effective potential on the control elements 6 and 10 of the amplifiers 2 and 3 with respect to their respective cathodes will be determined by the sum of these two sources of potential and by the potential on resistance 35. This biasing potential is normally such that these devices operate principally as amplifiers, and with substantially a minimum of detecting effect.

As already explained the resistance 28 is connected in a circuit including the output circuit of the detector 11. Hence the direct

current which flows in the output circuit of the detector 11 flows through the resistance 28. Since this current varies in response to the intensity of the high frequency impulses which are impressed upon the detector 11, the potential upon the resistance 28 will correspondingly vary. I utilize this potential upon the resistance 28 as a means for controlling the amplification of the radio amplifiers 2 and 3. To this end, the amplifier 43 having an anode 44, a cathode 45 and a control electrode or grid 46 is employed. A suitable source of potential is impressed upon the control electrode 46 with respect to the cathode 45 through an input circuit including the cathode 45, cathode conductors 23, conductor 24, source of potential 27, resistance 28 which constitutes a variable source of potential, conductor 29, adjustable tap 47, that portion of the resistance 48 which is between the adjustable tap 47 and adjustable tap 49, adjustable tap 49, that portion of the source of potential 50 which is between the contact 49 and conductor 51, conductor 51 to the control electrode 46. A portion of the source of potential 50 is closed circuited through the adjustable tap 49, resistance 48 and conductor 52. The purpose of this arrangement will be seen later. A suitable potential is impressed upon the anode 44 of the amplifier 43 with respect to the cathode 45 through an output circuit including the cathode 45, cathode conductors 23, conductor 24, that portion of the source of potential 27 which is between the conductor 24 and the adjustable tap 24', adjustable tap 24', resistance 35, conductor 53 to the anode 44.

For the purpose of preventing alternating current from being supplied from the output of detector 11 to the input of the amplifiers 2 and 3 through the volume control circuits the condenser 55 is inserted between the conductor 29 and the cathode conductors 23 and condenser 56 between the conductor 41 and cathode conductor 23.

The operation of the circuit is as follows: During normal operation when the volume of the received signal is at or below a predetermined level, current will be flowing in the anode circuit of the detector 11 and through the resistance 28. The sum of the potentials in the control circuit of the amplifier 43 which includes the source of potential 27, resistance 28, a portion of resistance 48, and that portion of the source of potential 50 which is between the adjustable contact 49 and the conductor 51 will be such that a strong negative potential will be impressed upon the electrode 46. This being the case, no current will flow in the anode circuit of the amplifier 43 and as a result no voltage will appear upon the resistance 35. The sum of the potential 37 and that portion of the source of potential 27, which is between the adjustable contact 24' and the conductor 24, is such that the am-

plification of the amplifiers 2 and 3 will be a maximum and reception will take place in the usual way.

Now assume that a signal of higher intensity is impressed upon the receiving system. Then the voltage on the resistance 28 will diminish and the source of potential 27 will become effective upon the electrode 46 causing it to assume a less negative or even positive potential depending upon the intensity of the received high frequency impulses. Hence, current will flow in the anode circuit of the amplifier 43 and through the resistance 35 causing a voltage to appear upon this resistance having the polarity indicated in the drawing. Since this voltage is in series with the source of potential 37 in the circuit of the control elements of the amplifiers 2 and 3, the potential upon the control elements will be increased in a negative direction, thereby correspondingly diminishing the amplification of the circuit and thereby diminishing the intensity of the signals at the receiver.

This operation may best be understood by reference to Fig. 2 in which I have plotted the intensity of the high frequency impulses which are impressed upon the receiving circuit as abscissæ and the intensity of the signal at the head phones for any given percentage modulation as ordinates. The curve 1 represents the operation of the circuit when the potential upon the electrode 46 of the amplifier 43 is so strongly negative that no current flows through the anode circuit of this amplifier or through the resistance 35. Assume that it be desired to maintain the volume of the received signals at the head phones at a level indicated by the curve 2. The contacts 47 and 49 will be adjusted to impress a negative potential on the control electrode 46 such that no current will flow through the resistance 35 until the high frequency impulses impressed upon the detector are of such volume as to produce a signal at the head phones corresponding to the level represented by the curve 2 at the given percentage modulation. Then for all high frequency intensities which produce signals below this level the amplification of the circuit will be at a maximum and reception will take place on the curve 1. If the volume of the high frequency impulses which are impressed upon the detector 11 become so great as to cause the volume of the received signal at the head phones to exceed the level represented by the curve 2 then the negative potential on the electrode 46 will be so diminished that current will flow through the anode circuit of the amplifier 43, causing a diminution in the amplification of the amplifiers 2 and 3. Hence, all high frequency impulses which produce signal intensities above the level 2 at the given modulation will be diminished to this level, whereas, intensities below this vol-

ume level will be unaffected. If it be desired to increase the volume level of the received signal, then the contacts 47 and 49 may be so adjusted that a stronger negative potential will be impressed upon the grid 46. With such an adjustment a greater volume must be impressed upon the resistance 28 before the negative potential on the electrode 46 will be sufficiently diminished to permit the flow of current through the anode circuit of the amplifier 43. Hence, only intensities above those represented by the curve 3 will be diminished and reception will take place on the curve 3. By adjusting either of the contacts 47 or 49 in the opposite direction reception can be made to take place upon the curve 4.

With the potentiometer contact 47 adjusted to impress any desired bias on the grid of the direct current amplifier, current starts to build up in the anode circuit of the amplifier at a corresponding critical value of input radio frequency voltage to the detector. As the radio frequency input voltage to the detector increases beyond this critical value the current in the direct current amplifier increases extremely rapidly, and in a substantially linear relation to the radio frequency input voltage. In this way sufficient control of the amplification is had to maintain the volume of signal at the headphones within a satisfactorily small range of variations in intensity.

In Fig. 3 of the drawing I have shown a modification of my invention in which the amplifier 46 has been omitted. It will be seen that in this case conductors 39 and 41 are connected through the source of potential 37 and the resistance 48', which have been connected in parallel relation for purposes of adjustment, adjustable contact 54 and conductor 55 to the point on the resistance 28, which is connected to the output circuit of the detector 11. Hence, it will be seen that any fluctuations in the potential of the resistance 28 will be impressed directly upon the control circuits of the amplifiers 2 and 3. An arrangement of this type may be preferable in a circuit where only small adjustments are required as where the changes in the characteristics of the transmission media are small, or in a circuit where a number of amplifiers are used, such that the adjustment is effective upon a number of amplifiers. This arrangement effects a substantial economy in the apparatus required.

While I have described my invention with particular reference to a common receiving circuit employing a particular type of detector it will be apparent that it is not so limited but rather that it may be employed in almost any type of high frequency receiving system where a contact volume of output is desired. Likewise, in the embodiment shown I have employed a detector as the controlling tube purely from considerations of economy in the

apparatus since, obviously, any type of rectifying device may be employed as well.

Furthermore, it will be apparent that the control device may be made to operate upon amplifiers subsequent in the circuit to the controlling tube 11 rather than prior to it as in the embodiment shown and that such an arrangement will have certain advantages such as results from the fact that it entirely eliminates regeneration or any tendency to oscillate. This also enables me to make condensers 55 and 56 of very small capacity, thereby eliminating any time delay in the operation of the device which may be produced by the charging of these condensers. However, I have found that with this arrangement greater difficulty is encountered in obtaining substantially horizontal characteristics as shown in Fig. 2 over a large range of intensities of impressed high frequency impulses, than is the case in the embodiment shown.

It may thus be seen that I have provided a volume control device which is simple in its circuit structure and its operation and which does not require the attention of a skilled operator, which operates directly in response to the high frequency impulses which are impressed upon the circuit rather than in response to changes in a pilot frequency which is transmitted over the same media as the received signal, or in response to current flowing in pilot wires, which are subjected to the same conditions as the media over which the received signal is transmitted, as has been done heretofore. My invention has the further advantage that it is completely electrical in its operation and does not involve any mechanical moving parts, such as motors, relays and the like, which introduce undesirable effects in the operation of the system. Hence my device is practically instantaneous in its operation. My invention has a further advantage in that it involves but a small amount of apparatus and that it may be applied with facility and without great expense to any of the usual signaling circuits.

While I have shown and described a specific embodiment of my invention, it will be apparent that it is not limited to the particular embodiment shown but that many modifications in the circuit arrangements and instrumentalities employed in carrying out my invention may be made without departing from the scope thereof as set forth in the appended claims.

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

1. The combination in a receiving circuit employing an electron discharge amplifier having a control element, a detector and connections whereby current having amplitude dependent upon the characteristics of the transmission medium are supplied to said amplifier and detector, a resistance connected

in the output circuit of said detector, an electron discharge device having an anode, a cathode and a grid, said resistance being connected between said cathode and said grid, a second resistance connected between the anode and cathode whereby the potential on said second resistance is dependent upon the output current of said detector and means for varying the potential on said control element in response to the potential on said second resistance thereby to control the amplification of said amplifier.

2. The combination, in a receiving circuit embodying an electron discharge amplifier having a control element, connections whereby current having amplitude dependent upon the characteristics of the transmission medium over which currents are received are supplied to said amplifier, means for rectifying a portion of said current thereby to produce a source of direct current potential which is variable in response to the intensity of the received current, means for amplifying said direct current potential and for supplying the amplified potential to the control element of said amplifier thereby to control the amplification in response to the intensity of the received current.

3. The combination in a signaling system, employing an electron discharge device having a grid, means for impressing a biasing potential on said grid such that said device operates principally as an amplifier and with a minimum of detecting effect, means for supplying current to be amplified to said grid, a second electron discharge device having an anode circuit, a cathode and a grid, means for impressing a uni-directional biasing potential on the grid of said second device such that substantially no current normally flows in the anode circuit thereof, means for varying said uni-directional biasing potential on the grid of said second device in response to the intensity of the received current and to cause current to flow in the anode circuit thereof when the intensity of received current exceeds a predetermined value and means for controlling the potential on the grid of said first device in response to the current in this anode circuit of said second device thereby to regulate the amplification of said first device.

4. In a high frequency receiving system, sound reproducing means, an electron discharge device having a grid, means for impressing high frequency potential on said grid, means for impressing a biasing potential on said grid such that said device operates principally as an amplifier of said high frequency current and with a minimum of detecting effect, additional means comprising an electron discharge detector for deriving audio frequency current from the amplified high frequency current and for supplying said current from said detector to the sound

reproducing means, and means including said detector for varying the direct current potential upon the grid of said first mentioned electron discharge device only when the high frequency input to said detector exceeds a predetermined value and then to vary said direct current potential substantially linearly with respect to variation in said high frequency input to said detector thereby to control the amplification of said electron discharge device.

5. In the operation of a carrier wave receiver of the type including a carrier wave amplifier, a detector and an audio frequency output circuit fed from said detector, the method of automatically reducing the effects of varying signal strength which comprises amplifying the direct current potential developed in the plate circuit of the detector, and impressing the amplified direct current potential upon said carrier wave amplifier to control the amplification thereof.

6. In a carrier wave receiver, the combination with a carrier wave amplifier, a detector and an audio frequency output circuit fed from said detector, of an impedance in the plate circuit of said detector, a direct current amplifier connected across said impedance, and circuit connections for impressing the amplified output of said direct current amplifier upon the carrier wave amplifier to control the amplification thereof.

7. A carrier wave amplifier of the vacuum tube type and including circuit elements for automatically impressing upon said amplifier an amplification-control voltage proportional to received signal strength, characterized by the fact that said circuit elements include a direct current amplifier.

8. In combination, an audion, an output circuit therefor, means for suppressing fluctuations in said output circuit due to variations in the strength of an incoming signal, said means comprising a rectifying system having a critical input voltage below which substantially no direct-current output is obtained, and means for adjusting said critical voltage.

9. In an electrical system, the combination with an audion having input and output circuits, of means for suppressing fluctuations in said output circuit due to variations in the strength of an incoming signal in said input circuit, said means comprising a rectifying system of the type having an approximately linear relation between direct-current output and radio frequency input above a critical input voltage, and means for varying the critical voltage of said rectifying system.

10. In an electrical system, the combination with an audion, of means energized by said audion for impressing a variable bias on said audion, said means having a critical working voltage, and means for adjusting said critical voltage.

11. The combination with an audion, of means for biasing said audion by a direct-current voltage, means for automatically varying said bias voltage in accordance with the strength of an incoming signal, at least one of said means comprising a rectifying system including an element having a critical working voltage, and means whereby said critical voltage may be adjusted.

12. In combination, an audion, an output circuit therefor, means for suppressing fluctuations in said output circuit due to variations in the strength of an incoming signal, said means comprising a rectifying system having a certain input voltage below which substantially no direct current output is obtained and above which said direct current output rapidly rises and attains an approximately linear relation with respect to the intensity of the signal applied to the input of said detector, and means for adjusting said certain input voltage.

In witness whereof, I have hereto set my hand this 31st day of December, 1926.

DEWEY T. SIMONDS.