

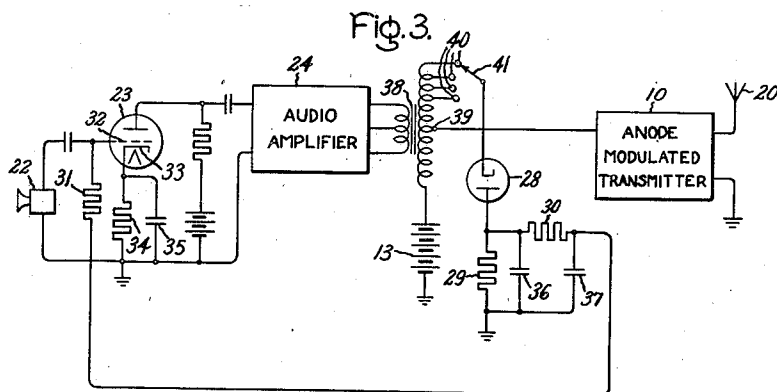
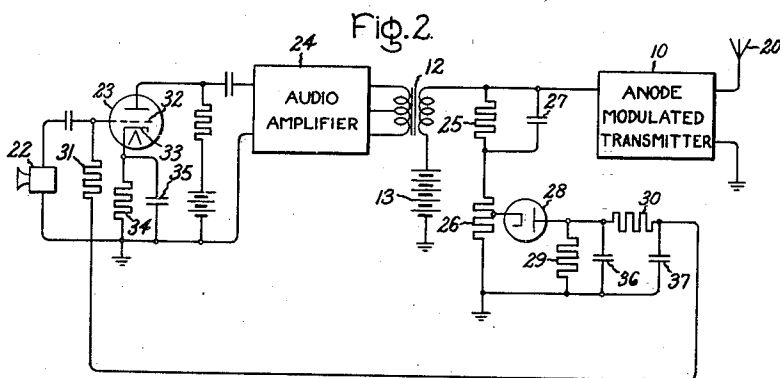
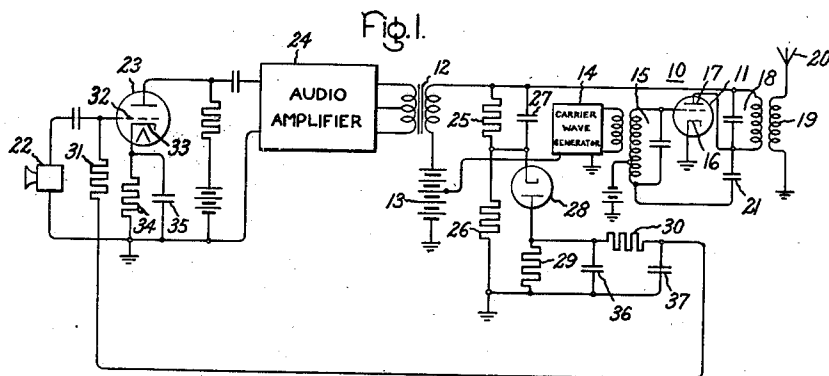
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MODULATION CONTROL SYSTEM

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MODULATION CONTROL SYSTEM

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1 Claim. (Cl. 179—171.5)

This invention relates to radio transmitters and more particularly to means for controlling the amount of amplitude modulation of the wave radiated thereby.

In a common type of radio transmitter a carrier wave amplifier is supplied with direct current through a modulation transformer upon which a signal is impressed. In such transmitters it has been proposed to control the amount of modulation of the carrier wave by controlling the amplification of the audio amplifier in accordance with a voltage developed in a diode rectifier connected in shunt to the modulation transformer and the direct current supply for the carrier wave amplifier. The diode is so poled as to be non-conductive in the presence of unidirectional potential in the circuit. In order that the diode shall become conductive and produce a control potential for the audio amplifier only when the unidirectional potential for the carrier wave amplifier is reduced to some predetermined voltage greater than zero, the diode has been maintained at some voltage positive with respect to ground. As a result, the control potential developed thereby for the audio amplifier has been superimposed upon a positive unidirectional potential.

It is an object of my invention to provide such a modulation control system in which the diode becomes conductive before the unidirectional potential for the carrier wave amplifier is reduced to zero, and in which the control potential developed in the system is not superimposed upon a positive unidirectional potential.

It is a further object of my invention to provide such an improved modulation control system in which a small, low voltage diode may be utilized, since the control potential produced thereby is not superimposed on a unidirectional potential.

It is another object of my invention to provide such an improved modulation control system in which the controlled amplifier circuit may be operated with one side connected to ground, since the control potential therefor is not superimposed on a positive unidirectional potential.

The features of my invention which I believe to be novel are set forth with particularity in the appended claim. 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 illustrates a radio transmitter embodying

my invention; and Figs. 2 and 3 represent certain modifications thereof.

Fig. 1 illustrates an anode modulated transmitter 10 comprising a carrier wave amplifier discharge device 11 supplied with unidirectional operating potential through a modulation transformer 12 from a direct current source 13. A carrier wave generator 14, also supplied with unidirectional operating potential from the source 13, transmits a carrier wave through a tuned circuit 15 to be amplified through the discharge device 11. The cathode 16 of the device 11 is connected to ground and the anode 17 thereof is connected through a tuned circuit 18 and through the secondary of the transformer 12 to the positive terminal of the source 13, whose negative terminal is connected to ground. The carrier wave from the generator 14, after passing through the tuned circuit 15 and device 11, is transmitted from the tuned circuit 18 to a coil 19 coupled therewith, which impresses the carrier wave on an antenna 20 from which the wave is radiated. The discharge device 11 is shown conventionally as a triode and conventional neutralizing means including a condenser 21 is provided therefor.

Audio signals from a microphone 22 are amplified through a variable gain amplifier 23 in cascade with an audio amplifier 24. The amplifier 24 transmits the amplified audio signal from the microphone 22 through the transformer 12 and thus superimposes the amplified audio signal upon the unidirectional potential from the source 13. The potential of the source 13 is thereby modulated in accordance with audio signal and the amplitude of the carrier wave amplified through the device 11 is consequently modulated in accordance with the amplified audio signal.

The radio transmitter with its modulating system is provided with automatic modulation control means to prevent the amplified audio signal from reducing to zero the unidirectional potential supplied through the tuned circuit 18 to the anode 17. It is well known that such reduction of the anode potential for the device 11, which is commonly called over-modulation, may cause the radio transmitter to emit undesired radiation. The modulation control system comprises a pair of serially connected resistors 25 and 26 connected in shunt to the source 13 and the secondary of the transformer 12. A condenser 27, sufficiently large to have a low impedance for low frequency audio signal currents, is connected in shunt to the resistor 25. A diode rectifier 28, serially connected with a resistor 29, is connected

in shunt to the resistor 26, and with such polarity that the unidirectional potential of the source 13 tends to maintain the diode 28 non-conductive. So long as the diode 28 remains non-conductive, that is, so long as there is no over-modulation, no potential is developed across the resistor 29. However, when the amplified audio signal superimposed on the unidirectional potential from the source 13 reaches a certain intensity with respect to the intensity of the unidirectional potential, so that the operating potential of the device 11 is reduced to a predetermined voltage greater than zero, a control potential is developed across the resistor 29, negative with respect to ground. The relative intensities of the amplified audio signal and the unidirectional potential, at which this control potential is produced, depend on the relative sizes of resistors 25 and 26, as will be explained later.

This negative control potential is transmitted through a resistor 30 and a second resistor 31 to a control electrode 32 of the variable gain amplifier 23. As the negative potential of the control electrode 32 is increased, the gain of the device 23 is reduced. The cathode 33 of the device 23 is connected to ground through a cathode resistor 34, bypassed for audio frequency currents through a bypassing condenser 35. Space current flowing through the resistor 34 maintains the cathode 33 at a constant positive potential, which maintains the control electrode 32 at a negative bias potential with respect to the cathode 33 to provide maximum gain through the device 23 when no voltage exists across the resistor 29.

It may be noted at this point that the cathode 33 of the device 23 is substantially at ground potential, the voltage across the resistor 34 being small. It is possible to have this amplifier circuit thus grounded because of the fact that the control potential developed across the resistor 29 is not superimposed upon a large unidirectional potential, which would make it necessary that circuits associated with the device 23 be maintained at a substantial potential with respect to ground.

Since the control potential developed across the resistor 29 is pulsating in character, a low pass filter, including the resistor 30 and condensers 36 and 37 connected from each end of the resistor 30 to ground, is provided to smooth the pulsating control potential before it is supplied to the electrode 32 of the device 23. The time delay of an impulse transmitted through the filter comprising resistor 30 and condensers 36 and 37 should be sufficiently small so that momentary increases of the amplified signal impressed through the modulation transformer 12 on the continuous potential from the source 13 may not occur at such speed as to produce actual over-modulation. Since some time delay is necessary in order to obtain smoothing action for the control potential across the resistor 29, it is desirable that a control potential be produced before the unidirectional operating potential applied to the device 11 is reduced completely to zero. It is for this reason that the modulation control circuit is adjusted to produce a control potential across the resistor 29 before the potential applied to the device 11 is reduced to zero.

The operation of the automatic modulation control means to effect this result is as follows. The resistors 25 and 26 act together as a voltage dividing resistor to impress across the diode 28

only a portion of the unidirectional potential from the source 13. The condenser 27, which has low impedance to audio signal currents, impresses substantially the entire amplified audio signal across the diode 28. These elements 25, 26 and 27, which act to impress the operating potential on device 28 in reduced intensity and the signal voltage on device 28 in substantially full intensity, are electrically passive. That is, they include no source of electromotive force, and impress a bias potential on device 28 derived entirely from the source 13 of operating potential. The resistors 25 and 26 and the condenser 27 therefore impress the unidirectional potential component of the modulated anode potential for the device 11 upon the diode 28 in reduced intensity while impressing the alternating potential component thereon at full intensity. The diode 28 produces a control potential across the resistor 29 whenever the alternating potential component impressed on it exceeds in maximum intensity the continuous potential component impressed on it. A control potential is therefore developed across the resistor 29 whenever the peak intensity of the alternating potential applied to the anode 17 of the device 11 exceeds a predetermined fraction of the unidirectional potential impressed thereon.

It has been found desirable to adjust the relative magnitude of the resistors 25 and 26 so that a control potential is produced across the resistor 29 when the anode potential for the device 11 is reduced to about 10 per cent of the potential of the source 13. This degree of control may conveniently be effected if the resistor 26 be made about nine times as large as the resistor 25. The values of the resistors 25 and 26 may, of course, be varied in any desired manner to achieve control at other signal levels.

In Fig. 2 many of the circuit elements are similar to those illustrated in Fig. 1 and are given like reference characters. The anode modulated transmitter comprising the generator 14, the tuned circuit 15, the device 11, and the tuned circuit 18 and coil 19 is not shown in detail. In this figure the diode 28, serially connected with the resistor 29, is connected in shunt only to a portion of the resistor 26, rather than in shunt to the whole resistor 26 as is illustrated in Fig. 1. In the case of a high power transmitter, where, for example, the source 13 may have a potential of about 2000 volts, a very large control potential may be developed by the resistor 29 in the circuit of Fig. 1. A very large control potential is not necessary to control the variable gain amplifier 23.

In such a high power transmitter the circuit illustrated by Fig. 2 is preferred, since the magnitude of the control potential developed across the resistor 29 is very conveniently reduced to a suitable magnitude and the diode 28 may accordingly be a very small, low voltage diode, as may be used in the circuit of Fig. 1 in a low power transmitter. By connecting the diode 28 and the resistor 29 in shunt only to a portion of the resistor 26, there is impressed on diode 28 only a portion of the unidirectional potential across the resistor 26 and only a portion, in the same ratio, of the alternating potential or audio signal across the resistor 26. The control potential which is produced on the resistor 29 therefore appears at the same relative intensity of the unidirectional potential of the source 13 and the amplified audio signal.

In Fig. 3 many of the parts are identical with those illustrated in Figs. 1 and 2 and are given like reference characters. In the circuit illustrated by this figure, however, the modulation transformer 12 is replaced by a different sort of modulation transformer 38, whose secondary winding is provided with an intermediate tap 39 and a plurality of taps 40 near one end. The other end of the secondary winding of the transformer 38 is connected to the positive terminal of the source 13, whose negative terminal is, as before, connected to ground. The transmitter 10 is connected to the intermediate tap 39 on the secondary of the transformer 38 and the serially connected diode 28 and resistor 29 are connected between ground and one of the taps 40 by a selector switch 41. As before, the diode 28 is connected with such polarity that the unidirectional potential from the source 13 tends to maintain it in non-conductive condition.

The modulation control circuit of Fig. 3 operates somewhat differently from those illustrated by Figs. 1 and 2. In this case the modulated anode potential supplied to the transmitter 10 is altered before application to the diode 28 by increasing the alternating component or audio signal thereof and maintaining the unidirectional component constant. As before, the diode 28 becomes conductive when the alternating potential component applied to it exceeds in maximum intensity the intensity of the unidirectional component applied thereto. Consequently, since the alternating potential component is increased in magnitude before being applied to the diode 28, a control potential is developed across the resistor 29 when the alternating potential component applied to the transmitter 10 reaches a maximum intensity, which is a predetermined fraction of the intensity of the unidirectional potential component applied to the transmitter 10. In other words, when the anode potential supplied through the transformer 38 to the transmitter 10 is reduced by the amplified audio signal to a predetermined value greater than zero, a control potential is produced across the resistor 29.

In the circuit of Fig. 3 the secondary of the transformer 38 actually acts as an autotransformer to increase the intensity of the amplified audio signal applied to the transmitter 10 before impressing it on the diode 28. Since the secondary of the transformer 38 has a very small resistance, the unidirectional potential of the source 13 is applied to the diode 28 without substantial change in intensity.

By operation of the selector switch 41 the amount of increase in the amplified audio signal, which is applied to the diode 28, may be adjusted so that a control potential across the resistor 29 is produced at various levels of the amplified audio signal with respect to the unidirectional potential of the source 13.

The advantages of the modulation control circuit described above rise principally from the fact that the resistor 29 in any case is connected directly to ground. The circuit arrangement which makes this possible, therefore, allows the use of a diode 28 of the low voltage type, such for example as a 6H6 diode or a 1V diode. It also allows the circuits associated with the amplifier device 23 to be connected to ground, rather than to a source of positive potential.

While I have shown a particular embodiment of my invention, it will, of course, be understood that I do not wish to be limited thereto, since different modifications may be made both in the circuit arrangement and instrumentalities employed, and I aim by the appended claim 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:

In a modulation responsive device for a high frequency amplifier having a cathode electrode and another electrode between which unidirectional operating voltage and modulating signal voltage are supplied, said operating voltage being subject to variations and the total voltage between said electrodes being subject to undesired reversal upon high peaks of said signal voltage, a unilaterally conducting device, an inductance, means for supplying said operating voltage to said device through said inductance with such polarity as to render said device non-conductive so long as peaks of said signal voltage do not exceed said operating voltage, means for applying said signal voltage between said electrodes across a portion of said inductance, and means for supplying said signal voltage across more of said inductance than said portion to said device, whereby said operating voltage and said signal voltage are applied to said device with such relative intensities that said device is normally non-conductive but becomes conductive whenever said signal voltage exceeds a predetermined constant fraction less than unity of said operating voltage on said device.

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