

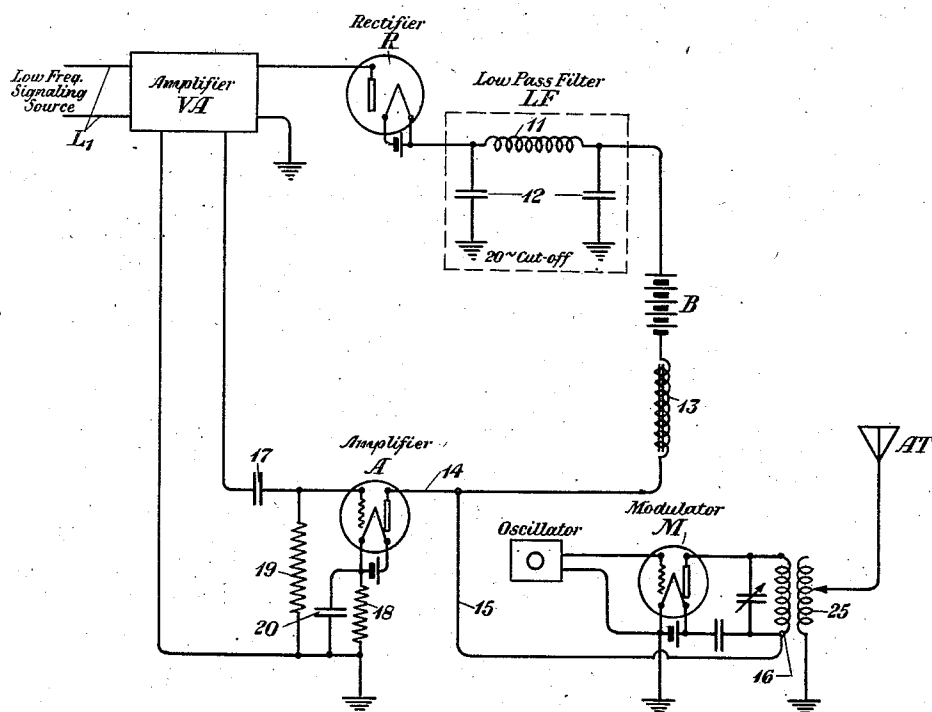
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CARRIER AMPLITUDE CONTROL IN RADIO SYSTEMS

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CARRIER-AMPLITUDE CONTROL IN RADIO SYSTEMS

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This invention relates to signaling systems, and more particularly to arrangements in such systems for controlling the amplitude of the carrier frequency thereof in accordance with the amplitude of low or voice frequency signals.

In radio systems for the transmission of modulated telephone and telegraph signals, especially in high power transmission systems, where a high field strength is ordinarily employed, the carrier frequency seems to be a source of considerable noise in a radio receiver when the carrier frequency is received by the radio receiver modulated by low frequency signals of low or of negligible amplitude. During the transmission of modulated telephone and telegraph signals, when the amplitude of the low frequency signals decreases, the noise is clearly heard in a loud speaker at the radio receiver. The noise, however, is not very desirable. But when the low frequency signals have a greater amplitude, the ratio between the modulation of these signals and the noise is not sufficient to be very noticeable at the radio receiver.

In this invention there is disclosed a signaling system which may be used for the transmission of carrier frequencies modulated by low frequency signals, in which the amount of the carrier radiated depends upon the level of the low frequency signals supplied to the system, to a considerably greater extent than is ordinarily the case.

It is an object of this invention to reduce the amount of noise which would normally be brought in at a radio receiver when a large amount of carrier is being transmitted during the intervals in which weak signals are being transmitted; and it is a further object to supply a sufficient amount of carrier to the system to satisfactorily demodulate one or both side bands that are transmitted without objectionable distortion when relatively high levels of modulated carrier frequencies are being transmitted. In other words, an object of this invention is to provide a system in which the carrier frequency employed bears a fixed relation to the low frequency signals

that are to be modulated on the carrier frequency.

Other objects and features of the invention will be better understood from the detailed description hereinafter following when read in connection with the accompanying drawing showing one embodiment of the invention applied to a radio transmitting system in which the carrier frequency is controlled as to its amplitude by the low frequency signals.

Voice frequencies from 50 to 10,000 cycles ordinarily vary in amplitude at a rate corresponding to a wave having a frequency of less than about 20 cycles. This variation represents the envelope of the voice frequencies. Generally, such low frequencies cannot pass through the voice frequency circuits. But when such low frequencies are considered as modulating the voice frequencies, they can then pass through the voice frequency circuits, the voice frequencies acting as the carriers of said low frequencies. Similarly, the voice frequencies cannot pass through radio frequency circuits, but when the voice frequencies are considered as modulating the radio frequencies, the voice frequencies can pass through the radio frequency circuits, the radio frequencies acting as the carriers of the voice frequencies. If ordinary voice frequencies are rectified and passed through a low pass filter, low frequencies corresponding to the volume variations in the voice of about 20 cycles or less, may then be utilized for controlling the amplitude of the carrier frequency.

Referring to the drawing, the reference character L_1 represents the leads connected to a low frequency signaling source which may be, for example, a voice frequency signaling source. These leads L_1 are also connected to an amplifier VA for the amplification of the low frequency signals coming from the source. This amplifier may be of any type capable of amplifying low frequency signals, preferably any well-known vacuum tube amplifier. Part of the energy passing from the amplifier VA goes to a rectifier R and a low pass filter LF. The rectifier R may be of any well-known type, preferably a rectifier oper-

ating on thermionic principle. The low pass filter may also be of any type capable of freely transmitting very low frequencies, frequencies of 20 cycles or less, and of substantially suppressing all higher frequencies. The filter may be of the type disclosed in the patent to G. A. Campbell, dated May 22, 1917, No. 1,227,113, having a series inductance 11 and shunt capacities 12. The rest of the energy passing the amplifier VA goes to another amplifier A. This amplifier A may also be of any well-known type, preferably a vacuum tube amplifier capable of amplifying low frequency signals.

An oscillator is designated by the reference character O. This oscillator may be of any type well known in the art, preferably a vacuum tube oscillator capable of setting up oscillations of the frequency to be employed in the system as the carrier frequency. A modulator M is connected to the oscillator O which is supplied with potential from a source B through a choke coil 13. The modulator M may be any modulator, preferably a vacuum tube modulator suitable for modulating a high frequency carrier wave by low frequency signals.

The low frequency signals that have been amplified by the amplifier VA pass through a rectifier R where these low frequency signals are rectified. After these low frequency signals have been rectified, they are passed through the low pass filter LF which smooths out changes in the amplitude of the rectified low frequency signals. The output of the low pass filter LF may be considered to be a low frequency wave corresponding to the envelope of the low frequency signals coming in over the leads L_1 , having a frequency of less than about 20 cycles. This low frequency wave freely transmitted by the low pass filter LF also corresponds to volume variations in the low frequency signals.

The low frequency wave rectified by the rectifier R and transmitted by the low pass filter LF causes changes in the potential of the source of battery B which is used to supply both the plate voltage for the amplifier A through the choke coil 13 and a conductor 14 and the plate voltage for the modulator M through the choke coil 13, the conductor 15 and the winding 16.

Thus, the magnitude of the potential of the battery B is controlled by the low frequency wave passing the rectifier R and the low pass filter LF. Since the amplitude of the carrier frequency is proportional to the magnitude of the voltage acting on the plate of the modulator M the amplitude of the carrier frequency will be changed in accordance with the magnitude of the potential of the battery B and therefore, also in accordance with the amplitude of the low frequency wave passing the rectifier R and the low pass filter LF. In other words, the amplitude of the

carrier frequency will be controlled by the low frequency signals coming in over the leads L_1 , so that the amplitude of the carrier frequency will bear a fixed relation to the amplitude of the low frequency signals. As the amplitude of the low frequency signals changes, the amplitude of the carrier frequency will also change.

Part of the energy passing the amplifier VA gets to the amplifier A, a condenser 17 being directly in the path leading to the grid of the amplifier A. There is a resistance 18 included in the path between the plate and filament of the amplifier A and ground, through which the low frequency wave transmitted by the rectifier R and the low pass filter LF passes. Thus, when this low frequency wave passes through the circuit of the plate and filament of the amplifier A and the resistance 18, there will be a drop in potential across the resistance 18 caused thereby. The drop in potential across the resistance 18 will vary with variations in the amplitude of the low frequency wave transmitted by the rectifier R and the low pass filter LF. Thus, when the amplitude of the low frequency wave transmitted by the rectifier R and the low pass filter LF increases, the drop in potential across the resistance 18 will increase, and vice versa.

This resistance 18 is also included in the input circuit of the amplifier A, the input circuit comprising the grid and filament of the amplifier A, the resistance 18 and another resistance 19. Therefore, when the drop in potential across the resistance 18 changes, there will be a corresponding change in the potential impressed upon the grid and filament of the amplifier A, effecting also a corresponding change in the output of the amplifier A. This all means that when the amplitude of the low frequency signals increases or decreases, the output of the amplifier A will increase or decrease accordingly. A condenser 20 shunts the resistance 18 for all high frequency currents. Any undesirable variation in the current flowing between the plate and filament of the amplifier A is kept from acting on the grid of the amplifier A by the condenser-resistance filter through which the potential of the grid is supplied.

The modulator M acts to modulate the carrier frequency of the oscillator O by the low frequency signals coming in over the leads L_1 , amplified by the amplifier VA and the amplifier A, the amplitude of the carrier frequency being controlled by the amplitude of the low frequency signals. When the amplitude of the low frequency signals changes, the output of the modulator M will correspondingly change.

An inductance 25 is so related to the inductance 16 that the carrier frequency modulator by the low frequency signals will be transmitted to a transmitting antenna ar-

range ment AT. The transmitting antenna arrangement AT is in series with the inductance 25, and the amount of the inductance 25 is adjusted by a movable arm associated therewith.

It is to be understood that whatever frequencies have been mentioned herein have been given merely for the purpose of illustration, and in practice other frequencies may be used as conditions necessitate.

While the arrangements disclosed herein are particularly suitable for the transmission of carrier frequencies modulated by low frequency telegraph signals, it is to be distinctly understood that modifications of these arrangements may be made within the scope of the invention so as to render them suitable for the transmission of carrier frequencies modulated by low frequency telephone signals.

It will also be understood that while the arrangements of this invention have been shown with particular reference to the control of the carrier frequencies employed in transmission systems, the invention may be embodied in other systems and in other and widely varied organizations without departing from the spirit of the invention and the scope of the appended claims.

What is claimed is:

1. In a signaling system, a source of voice frequency signals, means for selecting from said voice frequency signals a low frequency wave corresponding to changes in the amplitude of said voice frequency signals, a carrier frequency oscillator, a direct current source of potential associated with said carrier frequency oscillator, and means for varying the magnitude of the potential of said direct current source in accordance with changes in the amplitude of the voice frequency signals, the amplitude of the carrier frequency of said oscillator varying with the potential of the direct current source associated therewith, and means for modulating the controlled carrier frequency by the voice frequency signals.

2. In a signaling system, low frequency signals of varying amplitude, a carrier frequency generator, a source of potential associated with said generator, means for controlling the potential of said source associated with the carrier frequency generator in accordance with the envelope of the low frequency signals, and means for modulating the controlled carrier frequency by the low frequency signals for transmission to a distant point.

3. In a signaling system, low frequency signals, means for selecting from the low frequency signals, a wave corresponding to changes in the amplitude of the low frequency oscillator, a source of potential associated with said carrier frequency oscillator, the potential of said source being va-

ried in accordance with the periodicity of the selected wave, means for modifying the amplitude of the carrier frequency as changes occur in the potential of said source, and means for superimposing the low frequency signals on the modified carrier frequency for transmission to a receiving station.

4. In a signaling system, low frequency signals, means for selecting from the low frequency signals a wave corresponding to the envelope of the low frequency signals, means for rectifying the selected wave, a carrier frequency oscillator, a source of direct current potential associated with said oscillator, means for modifying the magnitude of the potential of the direct current source by an amount proportional to the amplitude of the wave selected from the low frequency signals and rectified by said rectifying means, the amplitude of said carrier frequency varying with the magnitude of the potential of said direct current source, and means for superimposing the low frequency signals on the modified carrier frequency for transmission to a distant station.

5. In a signaling system, a source of low frequency signals of varying amplitude, a carrier frequency oscillator, a source of potential associated with said oscillator, means for changing the potential of said source associated with said oscillator as the amplitude of the low frequency signals changes thereby causing a corresponding change in the amplitude of the carrier frequency, and a modulator for modulating the carrier frequency of said oscillator by the low frequency signals.

6. In a system in which a carrier frequency is modulated by the low frequency signals, a source of low frequency signals, a carrier frequency generator, means for controlling the amplitude of the carrier frequency of said generator in accordance with the amplitude of the low frequency signals, said means comprising a filter for selecting from the low frequency signals a frequency corresponding to the envelope of the low frequency signals, a rectifier for rectifying the selected frequency, a direct current potential associated with said carrier frequency generator which is changed in amplitude in accordance with the nature of the selected and rectified wave, the amplitude of the carrier frequency being modified by changes in the direct current potential, and a modulator for modulating the controlled carrier frequency by the low frequency signals.

7. In a signaling system, a source of low frequency signaling oscillations of varying amplitude, a source of high frequency oscillations, a filter for selecting from the low frequency signaling oscillations a wave representing the variation in the amplitude of the low frequency signaling oscillations, means for controlling the amplitude of said high

frequency oscillations in accordance with the nature of the wave selected from the low frequency signaling oscillations, a modulator for modulating the low frequency signaling oscillations and the high frequency signaling oscillations controlled as to their amplitude, and means for transmitting the products of modulation.

8. In combination, a variable impedance device having a space discharge path, a second device having a space discharge path, said devices having said discharge paths effectively connected in parallel, a source of space current common to said devices, means independent of said variable impedance device for producing alternating current variations in the discharge path of the second device, means for varying the impedance of the variable impedance device, a low frequency choke coil connected to said source of space current, and means including a rectifying element in series with said source of space current and said discharge paths for varying the current in the circuit including said source of space current.

9. In combination, a variable impedance device having a space discharge path, a second device having a space discharge path, said devices having said discharge paths effectively connected in parallel, a source of space current common to said devices, a low frequency choke coil connected to said source of space current, means independent of said variable impedance device for producing alternating current variations in the discharge path of the second device, means for varying the impedance of the variable impedance device, and additional means including a rectifying element for varying the current in the circuit which includes said source of space current and said discharge paths.

10. The combination of two variable impedance devices each having a space discharge path, said space discharge paths being coupled effectively in parallel relationship with each other, a source of current common to said space discharge paths, a low frequency choke coil associated with said source of current, means for bringing about alternating current fluctuations in the space discharge path of one of said variable impedance devices, means for bringing about signal variations in the discharge path of the second variable impedance device, and means including a two-electrode rectifying element for varying the magnitude of the current in the circuit of said source of current and said space discharge paths.

11. A modulating system comprising a first device and a second device, each having a space discharge path, said discharge paths being coupled effectively in parallel relationship with each other and being mutually reactive, means for transmitting current through said discharge paths at a constant rate, means for varying the electronic flow

of the first discharge path in accordance with signals, and independent means including a rectifying element for varying the electronic flow of the second discharge path in accordance with other signals.

In testimony whereof, I have signed my name to this specification this 29th day of December, 1925.

RUSSELL S. OHL.