

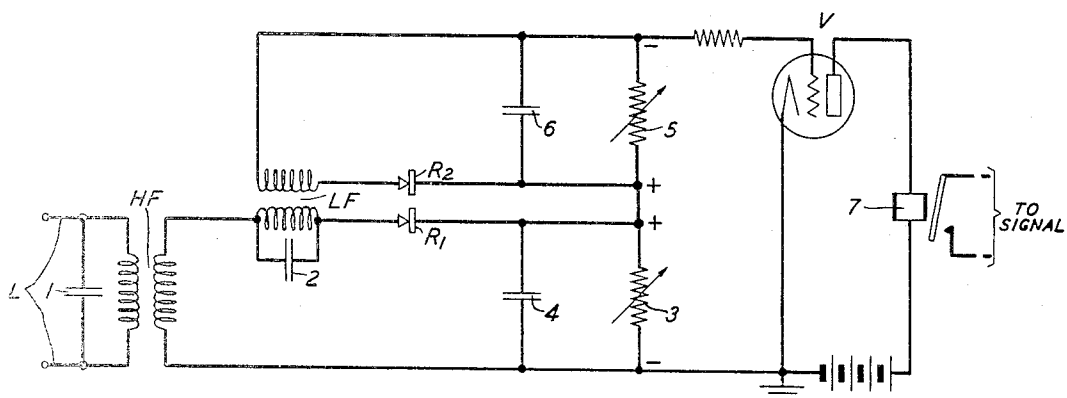
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SIGNALING SYSTEM

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SIGNALING SYSTEM

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This invention relates to voice frequency signaling systems and more particularly to arrangements for receiving and translating a modulated voice frequency signal wave, to control a signal device, as for example, 1000 cycles interrupted at the rate of twenty times a second as disclosed in the patent to P. B. Murphy No. 1,537,655, issued May 12, 1925.

In present systems of the above character, for example the arrangement disclosed in the co-pending application of G. A. Pullis, Serial No. 389,335, filed April 19, 1941, a modulated or interrupted voice frequency carrier is applied to a detector tube and the resultant low frequency output is applied to the input of a vacuum tube amplifier, the output of which is rectified and the resultant unidirectional current used to control a signal device, usually through the medium of a relay.

In order to prevent false operation of the signal device by low frequency speech currents, it is necessary to rather closely tune the amplified low frequency output, before rectification, to the low frequency component of the signal wave, i. e., 20 cycles, which tuning materially attenuates the energy delivered to the rectifier and consequently the value of the unidirectional current delivered to the relay.

Due to the fact that any amplifier tube is distinctly limited as to its maximum output, it is obvious that the operate current requirement of the signal relay may be very close to the available energy delivered by the rectifier which may eventually cause unsatisfactory signal reception for the reason that the output of the vacuum tube amplifier may, in time due to aging of the tube, be reduced sufficiently to fail to operate the relay.

An object of the invention is to provide improved means for receiving and translating modulated voice frequency signal current to control a signal device.

A feature of the invention resides in applying the modulated signal wave to a rectifier, the output of which contains a direct current component due to the high frequency carrier, and a low frequency alternating current component due to the rate of modulation. The direct current component is applied, by means of a resistance coupling, to the grid of a normally conducting vacuum tube, whose output circuit includes a signal relay, which direct current is applied in such a direction as to make the grid of the tube positive with respect to the cathode. The output circuit of the rectifier also includes the primary of a transformer tuned to the low frequency component (20

cycles), the secondary of which is connected to a second rectifier the direct current output of which is also applied to the grid of the vacuum tube by means of a second resistance coupling but in a direction to oppose the positive potential due to the first rectifier.

The tube circuit is arranged so that with no input the grid bias is low and the plate current high, thereby holding the relay in the output circuit operated and the signal circuit open.

The transformer in the output of the first rectifier increases the voltage of the 20 cycles applied to the second rectifier and the values of the two coupling resistances are so chosen that with proper modulation (20 cycles) the resulting potential on the grid of the tube will be negative by an amount sufficient to reduce the current in the plate circuit to a value insufficient to maintain the relay operated thus operating the signal device.

If, however, the percentage of modulation is reduced then the output current of the second rectifier will be reduced and the output of the first rectifier will be increased. Also, if the rate of interruption is reduced, for example to fifteen per second, the output current of the second rectifier will be reduced as before, due to the tuning of the transformer, and the output current of the first rectifier will remain constant. In both of the above cases therefore it will be noted that the grid of the amplifier tube will become more positive thus preventing operation of the signal device.

The invention will be understood from the following description and the accompanying drawing which shows schematically the basic arrangement.

Referring to the drawing a telephone transmission line L terminates in the primary winding of a transformer HF tuned to the frequency of the basic or carrier frequency (for example 1000 cycles) by means of condenser 1 and the output of the secondary winding is applied to a rectifier R₁ in series with the primary of a transformer LF tuned to the modulating frequency of the carrier, in the present example 20 cycles, and by means of condenser 2.

The direct current output of the rectifier R₁ is applied to the input of the vacuum tube amplifier C by means of a coupling resistance 3 in such a direction as to make the grid electrode positive with respect to the cathode. A condenser 4 is connected in parallel with resistance 3 whose obvious function is to maintain a substantially steady potential across the resistance

3 and consequently a steady potential on the grid. The secondary winding of the tuned transformer LF supplies a low frequency voltage to a second rectifier R₂ whose direct current output voltage is also applied to the grid of the tube V by means of coupling resistance 5 which is connected in series with resistance 3 to the input circuit of the tube. Rectifier R₂, however, is connected in such a manner that its output voltage is negative towards the grid of the tube C. In other words the voltage outputs of rectifiers R₁ and R₂ are in series opposing relation to each other whereby the effective grid bias of tube V is the difference between the potentials across resistances 3 and 5. Across resistance 5 is also connected condenser 6 whose function is to maintain a substantially steady potential across resistance 5.

Tube V whose output circuit includes a relay 7 has its constants so chosen that with no input the grid bias is low, in practice substantially zero, and its output or plate current high, thereby holding relay 7 operated.

The values of coupling resistances 3 and 5 are also so chosen that upon receipt of a correctly modulated signal wave, for example 1000 cycles interrupted at the rate of twenty times a second, the potential across resistance 5 will be considerably greater than the potential across resistance 3, for example, 30 per cent and therefore it will be obvious that the grid of tube V will be negative. The plate current will be reduced, and relay 7 will release thereby closing its back contacts to control a signal device (not shown). On the other hand if we assume that the frequency of modulation is reduced, for example to fifteen interruptions per second, the transformer LF will not deliver as high a voltage to rectifier R₂, due to its tuning, and therefore the direct current voltage output of the rectifier will be insufficient to overcome the voltage of the first rectifier R₁ and consequently the grid of the tube V will be positive and relay 7 remains operated thus preventing operation of the signal device.

What is claimed is:

1. In a signaling system, a source of carrier waves interrupted at a predetermined low frequency rate, a normally conductive thermionic vacuum tube, a relay in the output circuit thereof and normally operated by the current flowing therein, a signal device controlled by said relay, circuit means connecting said source to the input circuit of said tube and serially including a rectifier so poled that the grid of said tube will not be less positive than normally, means in series with said rectifier resonant to said low frequency, a second circuit inductively coupled to said resonant means and also connected to said input circuit and another rectifier serially included in said second circuit, so connected as to apply a potential of opposite polarity to said grid.

2. In a signaling system, a line, a source of alternating current within the speech frequency range interrupted at a subaudible rate, connected to one end of said line, a signal relay at the other end of the line and means for actuating said relay responsive to said interrupted alternating current, said means including a vacuum tube amplifier, an output circuit therefor including said relay, a first rectifier, a first resistance, and a transformer tuned to said low frequency, a circuit serially including said first rectifier, resistance, and the primary of said transformer connected to said line, a second rec-

tifier, and a second resistance, a circuit serially including the secondary of transformer, the second rectifier, and the second resistance, and an input circuit for said vacuum tube serially including said first and second resistances connected in such a direction that the respective potentials thereacross are in opposing direction with respect to each other.

3. In a signaling system, a line over which is transmitted an alternating current signal within the audible frequency range modulated at a predetermined subaudible rate, a vacuum tube amplifier having an input circuit including the amplifier grid and a pair of resistances, an output circuit for said amplifier, a relay serially connected therein, the constants of said output circuit being so chosen that in the absence of a negative potential on said grid a sufficient output current will flow to hold said relay operated, a first rectifier, a first circuit connected to said line serially including said first rectifier and a first one of said resistances, a second rectifier, a second circuit serially including said second rectifier and the other resistance, and means in said first circuit tuned to said subaudible frequency for coupling said second to said first circuit, said rectifiers being poled in their respective circuits in such a direction that the resultant direct current potential across the first resistance will be positive toward the grid and the potential across the other resistance will be in an opposing direction thereto, and said resistances being of such respective values and the said coupling so adjusted that the resultant grid potential will be negative with respect to its cathode when the received signal is modulated at the predetermined subaudible rate.

4. In a signaling system a line, an audible frequency wave interrupted at a subaudible frequency rate transmitted thereover, a signal receiving circuit comprising a vacuum tube amplifier, means connected to said line for rectifying the transmitted wave to derive a direct current therefrom interrupted at said subaudible rate, tuned means for selecting an alternating current from said interrupted direct current of a frequency corresponding to said subaudible rate, other means for rectifying said alternating current to derive a second direct current potential, and means for applying said direct potentials in series opposition to said amplifier to control said signal circuit.

5. The method of signaling which comprises interrupting an audible frequency wave at a subaudible frequency rate, transmitting the interrupted wave, rectifying the transmitted wave to derive a direct current therefrom interrupted at said subaudible rate, selecting an alternating current from said interrupted direct current of a frequency corresponding to said subaudible frequency rate of interruption, rectifying said selected alternating current to derive a second direct current, combining the potentials produced by said first and second direct currents in series opposition and translating the resultant potential into a signal.

6. The method of signaling which comprises modulating an audible frequency wave with a subaudible wave, transmitting the modulated wave, rectifying the modulated wave to obtain two direct current potentials one potential proportional to the audible frequency and the other proportional to the subaudible frequency, and combining the said direct current potentials in opposition to effect signal control.

7. The method of signaling which comprises modulating an audible frequency wave with a subaudible wave, transmitting the modulated wave, rectifying the modulated wave to obtain a first direct current potential proportional to the modulated wave and containing the sub-
audible component thereof, selecting and recti-
fying said subaudible component to obtain a second direct current potential proportional to said subaudible frequency and combining said first and second direct currents in opposing relation to effect signal control.

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