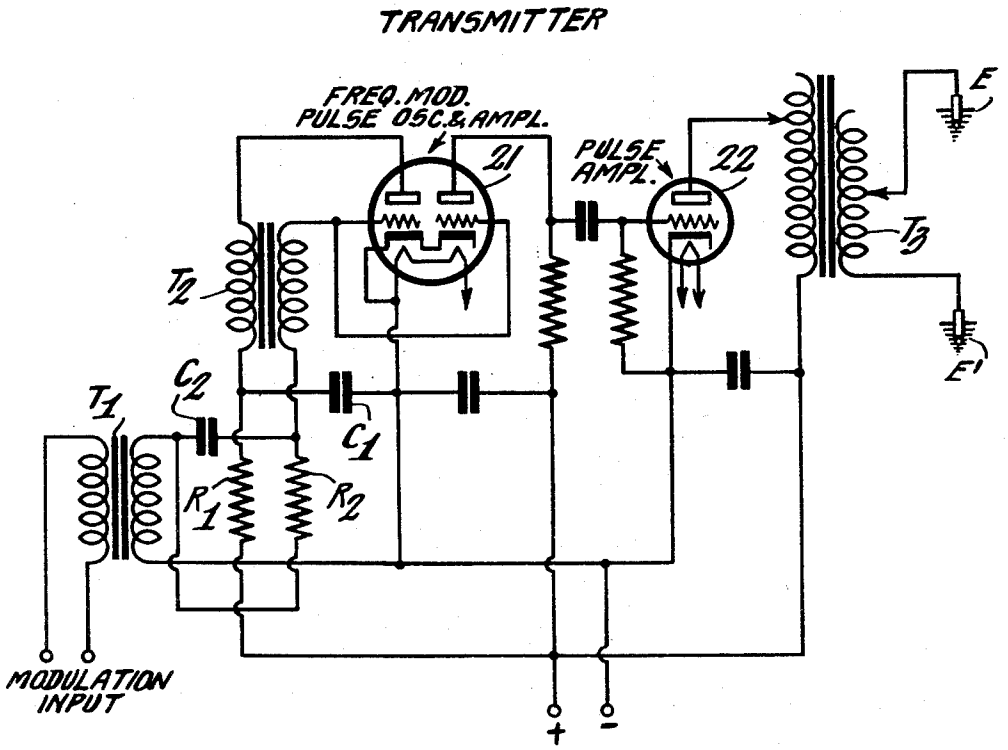
May 17, 1949. C. W. HANSELL 2,470,698

PULSE MODULATION SIGNALING SYSTEM

Original Filed June 24, 1942



INVENTOR.
Clarence W. Hansell
BY Harry Tunick
ATTORNEY

Patented May 17, 1949

2,470,698

UNITED STATES PATENT OFFICE

2,470,698

PULSE MODULATION SIGNALING SYSTEM

Clarence W. Hansell, Port Jefferson, N. Y., assignor to Radio Corporation of America, a corporation of Delaware

Application August 30, 1945, Serial No. 613,512, which is a division of application Serial No. 448,223, June 24, 1942. Divided and this application May 13, 1947, Serial No. 747,826

6 Claims. (Cl. 332—14)

1

The present invention relates to a signaling communication system employing electrical pulses, and is a division of my copending application Serial No. 613,512, filed August 30, 1945, now U. S. Patent 2,424,274, granted July 22, 1947, in turn, a division of my application Serial No. 448,223, filed June 24, 1942, now U. S. Patent 2,389,432 granted November 20, 1945.

Briefly stated, the present invention resides in the use of a novel system wherein short high-power pulses are delivered by the transmitter to a transmission medium. Intelligence is conveyed by a series of pulses which are modulated in phase or frequency in accordance with a characteristic of the modulations to be transmitted.

The communication system of the invention, employing short high-power pulses, has both military and civilian uses and possesses the following advantages among others; (1) A higher peak power can be transmitted than obtainable by the customary type of continuous wave transmitter equipment; (2) the system of the invention is very hard to interfere with, consequently the procedure known as "jamming" by an enemy in time of war has reduced effect; (3) by making the receiver of the invention operate synchronously with the transmitter, or by using an adjustable threshold system in addition to limiting, it is possible to receive transmitted pulse signals despite extraneous and undesirable earth potentials; and (4) the signals may be demodulated at the receiver without the necessity of inserting any fixed marker pulses.

The following is a more detailed description of the invention accompanied by a drawing whose single figure illustrates the improved pulse type transmitter of the invention.

Referring to the drawing, I have shown a frequency modulated pulse oscillator and amplifier comprising double element vacuum tube amplifier 21. One part of tube 21 is provided with regenerative feedback transformer T_2 and the time constant circuit made up of resistance R_1 and condenser C_1. The resistance R_2 and condenser C_2 provide a grid bias to the control electrode of the oscillator part of tube 21 and, if desired, may provide a time constant such as to contribute to the frequency of pulse oscillation.

The left hand portion of tube 21 constitutes the generator side, while the right hand portion of tube 21 is the amplifier side for the pulses produced in the generator side. Tube 22 is an amplifier which amplifies the output from the amplifier side of tube 21. The output from amplifier 22 is passed through transformer T_3 to the ground

2

connections E, E'. The primary and secondary windings of transformer T_3 are adjustable, as shown, to obtain the proper impedance match to the connecting circuits.

In the operation of the system of the invention, the oscillator electrode structure of tube 21 receives anode potential by the charging of condenser C_1 through resistance R_1. When the anode potential rises high enough, anode current starts, causing transformer T_2 to push the oscillator control electrode momentarily positive, thereby causig a rapid discharging of condenser C_1 and a charging of condenser C_2. The anode current then cuts off, leaving the anode potential low and control electrode bias potential high. Then, after a time, the bias potential decreases by leakage of charge from condenser C_2 through resistance R_2, while the anode potential rises by charging of condenser C_1 through resistance R_1, ending in another pulse of anode and grid current. This process repeated at rapid intervals (say at a rate of 20,000 pulses per second, with the pulses very short compared to the time intervals between them) provides the pulse oscillation. The pulses produced by the generator or oscillator side of tube 21 are D. C. pulses of constant width as distinguished from pulses or bursts of alternating current.

To modulate the frequency of the pulse oscillation, a modulating potential is applied through transformer T_1 and the parallel combination of resistance R_2 and condenser C_2. This causes a variation or modulation in the oscillator grid bias potential which causes anode current to start at variable time intervals following preceding pulses and thereby modulates the pulse frequency. It will be apparent from the foregoing that there is no modulation of a carrier but rather a modulation of the rate of occurrence of the D. C. pulses produced by the pulse oscillator.

The modulation may, as an example, comprise voice frequencies ranging from say 150 to 3000 cycles per second, and may be of such an amplitude as to modulate the pulse frequency by a maximum of plus and minus 3000 to 6000 cycles per second.

The frequency modulated pulses are amplified in the amplifier portion of tube 21 and again in tube 22 from which relatively high power pulses are delivered to the spaced ground connections E, E' through impedance adjusting transformer T_3. The resulting pulses constitute a series of constant width pulses which are modulated in phase or frequency, the time interval between

the pulses varying in accordance with the modulations to be transmitted.

What is claimed is:

1. A pulse modulation signalling system comprising a vacuum tube pulsing oscillator electrode structure, connections for causing said oscillator to periodically produce pulses of energy, said connections including a regenerative feedback transformer and a time constant circuit made up of a resistor and a capacitor, the bias potential for said oscillator being determined by the charge on said capacitor and the value of said resistor through which said charge leaks off, and a source of modulation coupled to the oscillator for varying the bias, to thereby modulate the pulse frequency.

2. A pulse modulation signalling system comprising a pulse oscillator having an electric discharge device provided with an anode, a cathode and a grid, a regenerative feedback transformer having first and second windings, a connection from one terminal of said first winding to said anode, a connection from another terminal of said first winding to said cathode through a condenser, a D. C. connection from said last terminal to the positive side of a source of unidirectional potential through a resistor, a D. C. connection from said cathode to the negative side of said source of unidirectional potential, a connection from one terminal of said second winding to said grid, a source of modulation, a connection from one terminal of said source of modulation to said cathode, a connection from another terminal of said source of modulation to another terminal of said second winding through a condenser, a resistor in shunt to said last condenser, and an output circuit coupled to one of said windings.

3. A pulse modulation signalling system comprising a pulse oscillator having an electric discharge device provided with an anode, a cathode and a grid, a regenerative feedback transformer having first and second windings, a connection from one terminal of said first winding to said anode, a connection from another terminal of said first winding to said cathode through a condenser, a D. C. connection from said last terminal to the positive side of a source of unidirectional potential through a resistor, a D. C. connection from said cathode to the negative side of said source of unidirectional potential, a connection from one terminal of said second winding to said grid, a source of modulation, a connection from one terminal of said source of modulation to said cathode, a connection from another terminal of said source of modulation to another terminal of said second winding through

a condenser, an amplifier provided with an anode, a cathode and a grid, direct connections between the grids and cathodes respectively, of said amplifier and oscillator, a resistive connection between the anode of said amplifier and the positive side of said source of unidirectional potential, a condenser connecting said resistive connection and said cathodes, and a pulse amplifier coupled to the anode of said first amplifier.

4. A pulse modulation signalling system comprising a vacuum tube oscillator provided with an anode, a cathode and a control grid, connections including a time constant circuit of resistance and capacitance for periodically varying the bias potential on said grid between values which permit anode current to flow and anode current to cut-off, and a source of modulation coupled between said grid and cathode for varying and grid bias potential and thereby cause anode current to start at variable time intervals, to thereby vary the pulse output frequency.

5. A pulse modulation system comprising a continuously operating pulsing oscillator provided with connections including a time constant circuit of resistance and capacitance of such values as to cause said oscillator to produce pulses of energy which are short compared to the time intervals between them, and a source of modulation of varying audio frequency coupled to said oscillator for varying the bias on said oscillator and thereby modulate the occurrence rate of the pulses generated by said oscillator, the pulses generated by said oscillator having a frequency at least twice that of the modulation frequency.

6. A pulse modulation system comprising a continuously operating pulsing oscillator provided with connections including a time constant circuit of resistance and capacitance of such values as to cause said oscillator to produce pulses of direct current which are short compared to the time intervals between them, and a source of modulation of varying audio frequency coupled to said oscillator for varying the bias on said oscillator and thereby modulate the occurrence rate of the pulses generated by said oscillator.

CLARENCE W. HANSELL.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,262,838	Deloraiñe et al.	Nov. 18, 1941
2,366,307	Anderson	Jan. 2, 1945
2,407,860	Wolf	Sept. 17, 1946