Feb. 18, 1947. H. E. THOMAS 2,415,920

MULTIPLE PULSE CHARACTERISTIC COMMUNICATION SYSTEM

Filed May 30, 1945

Fig. 1.

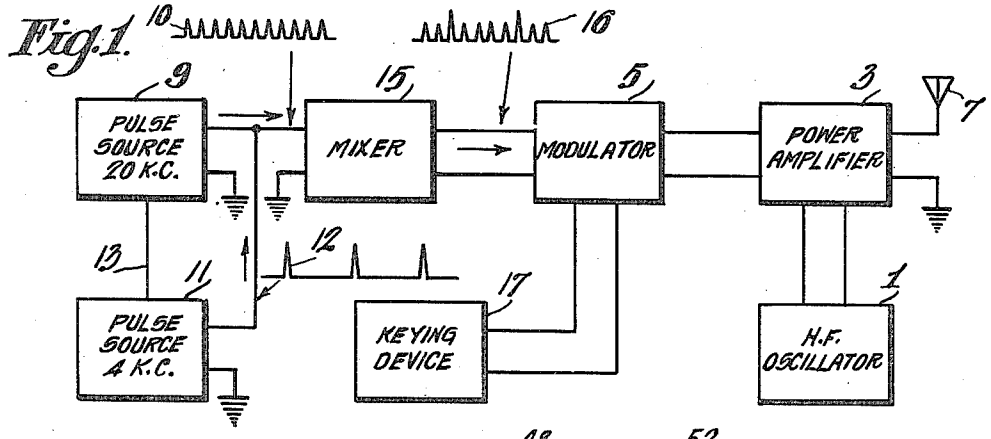
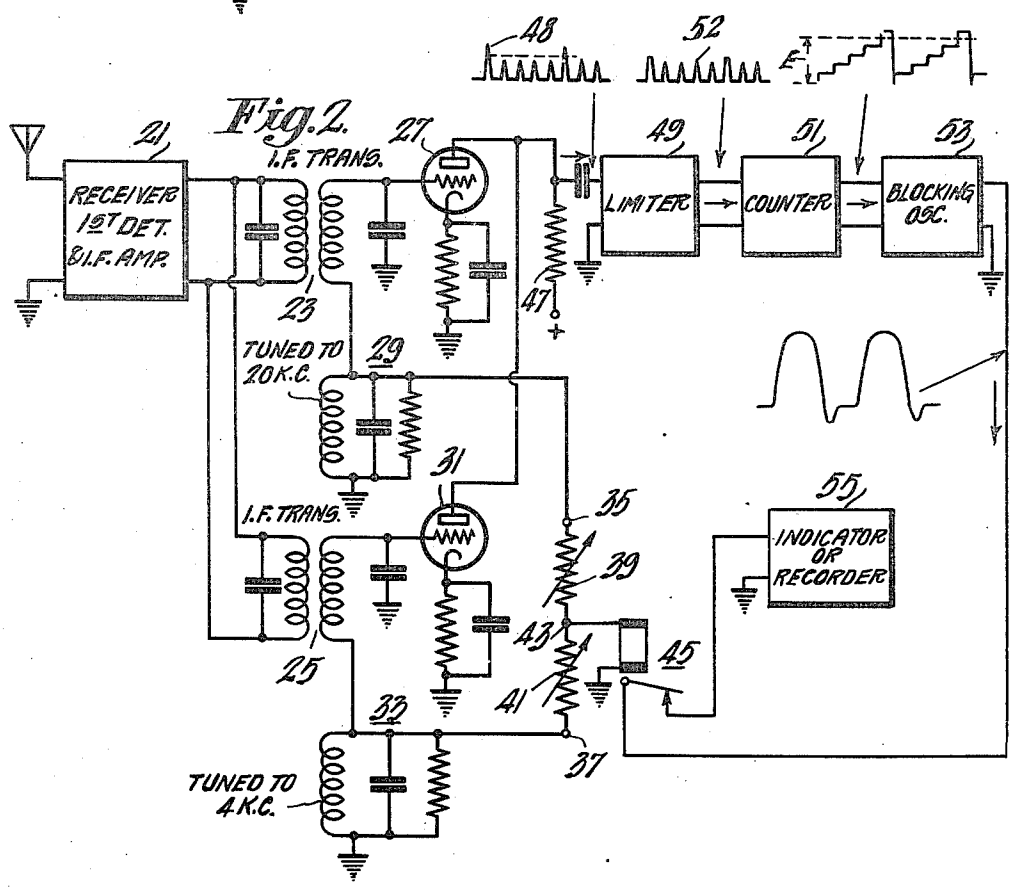


Fig. 2.



INVENTOR.
Harry E. Thomas
BY
C. D. Ruska
ATTORNEY

Patented Feb. 18, 1947

2,415,920

UNITED STATES PATENT OFFICE

2,415,920

MULTIPLE PULSE CHARACTERISTIC COMMUNICATION SYSTEM

Harry E. Thomas, Haddonfield, N. J., assignor to Radio Corporation of America, a corporation of Delaware

Application May 30, 1945, Serial No. 596,696

3 Claims. (Cl. 250—8)

1

This invention relates to the art of signalling with discrete pulses, and more particularly to improvements in pulse communication systems of the type described in copending U. S. patent application Serial No. 596,694, filed May 30, 1945, and entitled Multiple pulse characteristic communication system.

In systems of the described type, two trains of pulses of harmonically related repetition frequencies and of different amplitudes are transmitted simultaneously in dot-dash code groups or the like. The transmitted signal is received, demodulated, and applied to a counter circuit adjusted to count the higher frequency pulses and discharge at the frequency of the lower frequency pulses. A normally blocked oscillator is triggered by the counter output to actuate an indicator or other transducer.

The principal object of the present invention is to provide a method of and means for preventing energization of the transducer unless the respective amplitudes of the component pulse trains of the received signal are related to each other by a predetermined ratio.

The invention will be described with reference to the accompanying drawing, wherein:

Figure 1 is a block diagram of a transmitter system to be used in the practice of the present invention, and

Figure 2 is a schematic circuit diagram of a receiver system embodying the invention.

Referring first to Figure 1, the transmitter system includes a high frequency oscillator 1, a power amplifier 3, and a modulator 5. The output of the oscillator 1 is amplified by the amplifier 3, modulated by the modulator 5, and applied to an antenna 7, all in accordance with conventional practice. A pulse source 9 is arranged to produce brief voltage pulses 10 at a regular repetition rate of, for example 20 kilocycles per second. A similar source 11 produces pulses 12 at a repetition rate which is an integral fraction of that of the source 9, for example 4000 cycles per second. The sources 9 and 11 are synchronized by a connection 13 so that every *n*th (in the present example, every 5th) pulse from the source 9 coincides with a pulse from the source 11. The pulses from the source 11 are made from two to ten times the amplitude of those from the source 9.

The outputs 10 and 12 of the pulse sources 9 and 11 are applied to a mixer circuit 15, where they are added together to provide a pulse train 16 comprising a sequence of four low amplitude pulses and one high amplitude pulse, repeating cyclically. This pulse train is applied to the modulator 5, causing the transmitter to radiate a high frequency signal whose amplitude pulsates in accordance with the pulse train 16.

A keying device 17 supplies dot-dash or other

2

communication signals to the transmitter whereby the pulse train 16 is transmitted in dot-dash groups or the like.

The receiver system (Figure 2) includes a conventional radio receiver, preferably of the superheterodyne type, designed to respond to signals transmitted by the system of Figure 1. The usual radio frequency, first detector, and intermediate frequency amplifier stages are represented in Figure 2 by the block 21.

The intermediate frequency output from the unit 21 is applied to the primaries of a pair of intermediate frequency transformers 23 and 25. The secondary of the transformer 23 is connected to the control grid of an electron discharge tube 27, and through a parallel resonant circuit 29 to ground. The secondary of the transformer 25 is connected similarly to a tube 31 and a resonant circuit 33.

The resonant circuits are designed to offer negligible impedance to currents of the intermediate frequency. The circuit 29 is tuned to resonate at 20 kilocycles, and the circuit 33 is tuned to 4 kilocycles. The upper ends of the circuits 29 and 33 are connected to the respective terminals 35 and 37 of a voltage divider consisting of adjustable resistors 39 and 41, connected together at a point 43. The actuating coil of a relay 45 is connected between the point 43 and ground.

The anodes of the tubes 27 and 31 are connected together through a common load resistor 47 to the positive terminal of an anode supply source, not shown. The load resistor 47 is coupled to an amplitude limiter 49, whose output circuit is connected to a counter circuit 51. The output circuit of the counter 51 is connected to the synchronizing input terminals of a blocking oscillator 53. The oscillator 53 may be of the type commonly used in television circuits for producing sweep signals. The output circuit of the oscillator 53 is connected through the contacts of the relay 45 to a transducer 55, such as an indicator or recorder.

The adjustment and operation of the above described receiver system is as follows:

The radio and intermediate frequency unit 21 provides an output wave of intermediate frequency, pulse modulated like the output of the transmitter of Figure 1. This I.-F. output is applied through the transformers 23 and 25 respectively to the tubes 27 and 31, which function as second detectors by virtue of grid circuit rectification. A pulsating unidirectional voltage, corresponding in magnitude to the amplitude of the 20 kilocycle pulses of the received signal, appears across the tuned circuit 29. A similar voltage corresponding in magnitude to the 4 kilocycle pulses appears across the tuned circuit 23. The resistors 39 and 41 are adjusted to such values that the voltage at their junction point 43

is zero when the amplitudes of the 20 kilocycle pulses and the 4 kilocycle pulses bear a predetermined ratio to each other. When the two received pulse trains have some other amplitude ratio, the point **43** assumes a potential either positive or negative with respect to ground and the relay **45** is energized, breaking the connection between the oscillator **53** and the transducer **55**.

The anode currents of the tubes **27** and **31** pulsate in accordance with the pulsations of the intermediate frequency input. Both of these currents flow through the resistor **47**, producing a voltage drop which pulsates in the same manner. The limiter **49** is adjusted to operate at a level somewhat higher than the amplitude of the 20 megacycle pulses in the voltage **48** which appears across the load resistor **47**. The limiter output **51** comprises a 20 kilocycle train having every fifth pulse of substantially greater amplitude than the others. However, the difference is less than in the limiter input voltage **48**.

The counter **51** is adjusted so as to require five of the lower amplitude (20 kilocycle) pulses in order to build up to a predetermined voltage E. The oscillator **53** is adjusted to have a natural frequency of operation of 4000 cycles per second, but to be normally blocked until a voltage of magnitude E is applied to it.

The oscillator **53** will operate through one cycle upon the application of the critical voltage, discharging the counter and blocking itself until the counter output builds up again. Since the blocking oscillator tends to run at 4000 cycles per second, random pulses of noise or other interference will not control it; i. e. it waits for the synchronizing pulse from the counter circuit.

Every fifth step of the counter voltage is greater than the intervening steps, as a result of the higher amplitude of the 4 kilocycle pulses which are superimposed on the twenty kilocycle pulses. This affords an additional synchronizing effect on the oscillator, tending to trigger it at the proper time even if noise pulses are "counted" to some extent. The counter **51** is designed in accordance with well known principles to have substantially no response to pulses recurring at a frequency much lower than 20 kilocycles so that random noise pulses arriving in the absence of the 20 kilocycle signal will not cause operation of the oscillator **53**.

As long as the relative amplitudes of the 20 kilocycle and 4 kilocycle pulse components of the received signal bear the proper ratio to each other, the relay **45** is deenergized and the indicator **55** is operative in accordance with the dots and dashes of the 4000 cycle output of the oscillator **53**. However, if the predetermined amplitude relationship is not maintained correctly, the relay **45** is energized, rendering the transducer **55** inoperative even in the presence of pulses of the proper frequencies.

The pulse frequencies specified in the foregoing description are mentioned merely by way of example. Other integrally related frequencies may be used, and any practical number of superimposed pulse trains of different amplitudes may be employed in accordance with the principles set forth.

Briefly summarizing, the present invention contemplates the transmission and reception of superimposed trains of pulses of harmonically related repetition rates and different amplitudes, with means connected to the receiver responsive only to the simultaneous appearance of all of said pulse trains, in their predetermined frequency relations and amplitude ratios, to effect an indication.

I claim as my invention:

1. A signaling system including means for generating a plurality of trains of discrete pulses having respective repetition frequencies related to each other by integral numbers and having respectively different amplitudes, means for combining said trains to provide a composite signal, means for transmitting said composite signal, means for receiving said transmitted signal, limiter means adjusted to pass, without substantially limiting, the lowest amplitude component train of said signal, and to pass with substantial limiting, the higher amplitude components of said signal, counter means connected to said limiter means and responsive to the output thereof to produce a step-like voltage wave, a relaxation oscillator designed to operate at the frequency of said lowest frequency component pulse train, means biassing said oscillator normally to prevent operation thereof, means for applying said step-like wave to said oscillator whereby the effect of said bias is momentarily overcome at intervals corresponding to the frequency at which said oscillator is designed to operate, transducer means normally connected to said oscillator, and means responsive to the relative amplitudes of said component trains to disconnect said transducer from said oscillator unless said amplitudes bear a predetermined relationship to each other.

2. A signalling system including means for generating and transmitting a composite signal comprising at least two simultaneous trains of discrete pulses having respective repetition frequencies related to each other by a whole number and respectively different amplitudes, means for receiving said composite signal, indicator means responsive only to the simultaneous presence of both of the component trains of said signal to provide an indication, and means responsive to the relative amplitudes of said component trains to prevent operation of said indicator means unless said amplitudes bear a predetermined relationship to each other.

3. The method of communication including the steps of transmitting a composite signal including two superimposed trains of discrete pulses having repetition frequencies harmonically related to each other and respectively different amplitudes, receiving said composite signal, generating in response to the higher frequency component train thereof a further pulse train having the same frequency as the lower frequency component train, and effecting an indication only in response to both said lower frequency component train and said further pulse train; separating said component trains from said received composite signal in accordance with their respective frequencies, comparing the amplitudes of said separated trains, and preventing said indication unless said amplitudes bear a predetermined ratio to each other.

HARRY E. THOMAS.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,041,245	Haffcke	May 19, 1936
2,199,634	Koch	May 7, 1940