

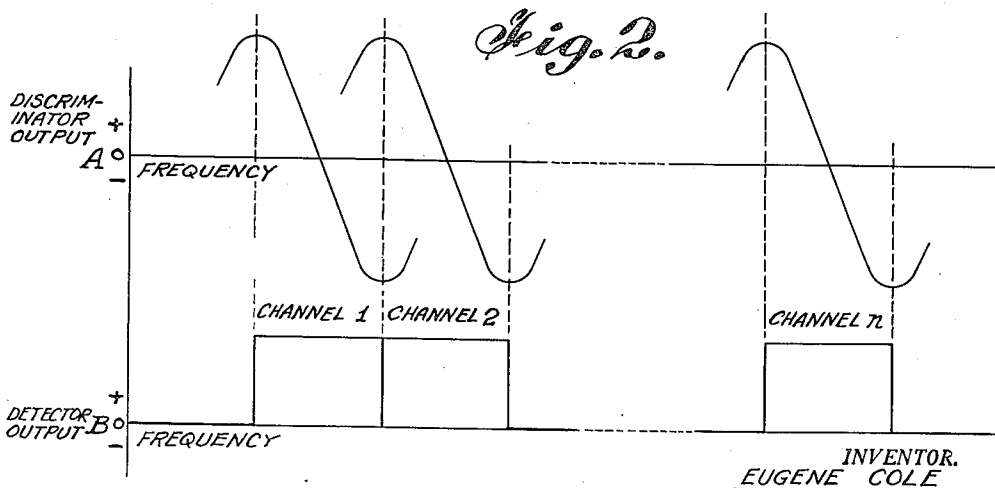
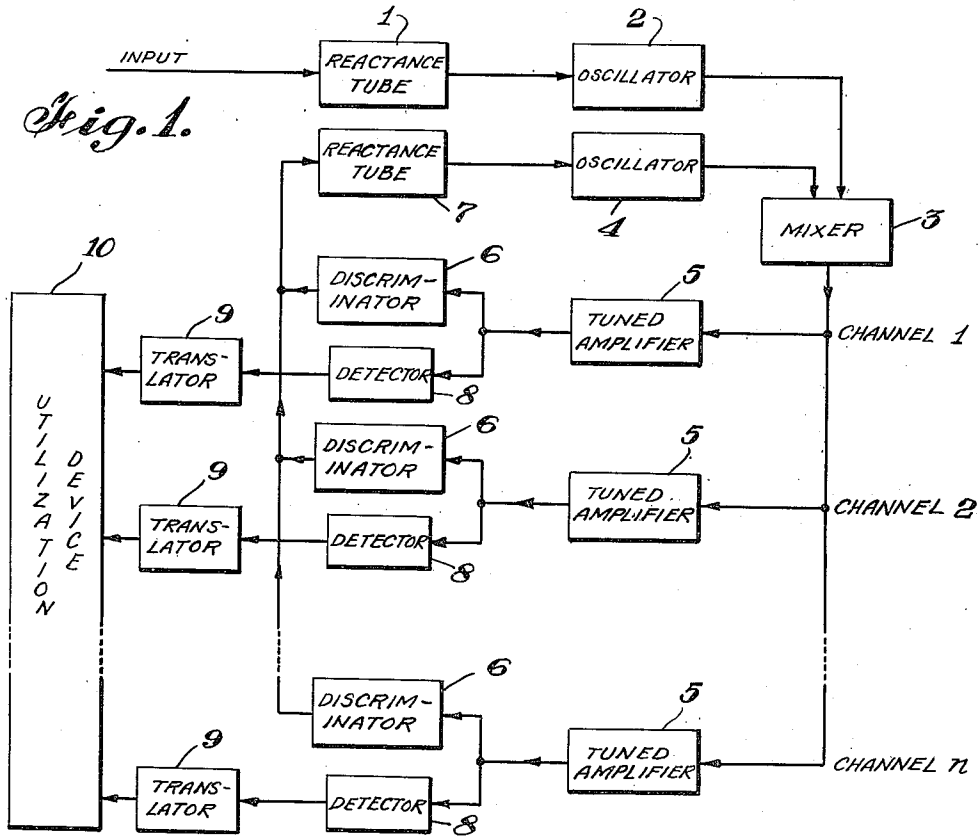
Dec. 27, 1949

E. COLE

2,492,134

PULSE CODING SYSTEM

Filed Nov. 29, 1947



INVENTOR.
EUGENE COLE

BY

R. P. Morris
ATTORNEY

UNITED STATES PATENT OFFICE

2,492,134

PULSE CODING SYSTEM

Eugene Cole, Kew Gardens, N. Y., assignor to
Federal Telecommunication Laboratories, Inc.,
New York, N. Y., a corporation of Delaware

Application November 29, 1947, Serial No. 788,894

4 Claims. (Cl. 250--27)

1

This invention relates to electrical selective translation circuits which may be termed amplitude class selectors. An amplitude class selector as here used refers to an apparatus which has for its function the classification of signals in accordance with the amplitude ranges within which said signals lie; and more specifically, the production of output indications on a channel specially reserved for signals having an amplitude lying within a given range.

Pulse separation systems for separating pulses and channelizing them in accordance with the range of amplitudes within which they lie have many applications. A system of amplitude class selection has been previously proposed for use in multi-channel communication systems utilizing time modulated pulses. The pulses of different channels have different amplitudes and they are separated at the terminal or at a drop channel relay station according to their amplitudes. In the previously proposed system it is desired that the time modulation of the pulses be retained at the relay station for those pulses which are to be retransmitted to some subsequent terminal station. In other systems it has been desirable to separate pulses according to their amplitudes and to count the number of pulses within given amplitude ranges. Such systems may be of especial utility in connection with nuclear counters for example.

Recently a number of systems of communication have been proposed, in which, instead of transmitting a continuously varying signal, there is transmitted instead a quantized signal; that is to say, pulse amplitude modulation is obtained from the signal, and the pulses are then quantized in amplitude. Whenever a given pulse has an amplitude lying within a specified range, another pulse having a fixed amplitude, representing all amplitudes within said range is transmitted instead of the original. By this process a continuously varying function is replaced by a function which takes on discrete values only.

An object of the present invention is to provide an improved amplitude class selector which relies for its operation upon the use of frequency sensitive circuits.

Another object of the invention is to provide an improved amplitude class selector which is equally suitable for the classification of pulses and for the quantization of continuously varying functions.

In accordance with a feature of the invention, a signal to be channelized in accordance with its amplitude is used to control the frequency of an oscillator, and the controlled frequency is then selected, or channelized, by means of frequency selective circuits.

2

In accordance with another feature of the invention, automatic frequency control means are arranged to control the frequencies applied to the above-mentioned frequency selective circuits so that although the frequency produced by said oscillator may vary over a limited range, the frequency applied to the input of the frequency selective circuits remains within narrow limits during said variation.

In accordance with a further feature of the invention, an auxiliary oscillator is used to provide a wave which is heterodyned with the output of the oscillator controlled in accordance with the amplitude of the input signal to be channelized, and the frequency of the auxiliary oscillator is controlled in accordance with the output of a discriminator connected to one of the above-mentioned frequency selective circuits.

The invention is described in connection with a plurality of channels each corresponding to a separate amplitude range and has particular application to the channelizing of pulses in accordance with their amplitudes. It may also be readily applied to the separation of a continuously varying function into a number of channels, as the function changes from one amplitude range to another.

The above mentioned and other features and objects of the invention and the manner of attaining them will become more apparent and the invention itself will be best understood by reference to the following description of an embodiment of the invention taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a block diagram of an amplitude class selector constructed in accordance with the principles of this invention;

Fig. 2 is a set of curves which will be used in explaining the operation of the system of Fig. 1.

Referring now to Fig. 1, I show a reactance tube 1 to which is applied the input complex wave form, which may be for example, a speech wave. Reactance tube 1 controls the frequency of an oscillator 2 which may be operated at any convenient frequency as, for example, 50 to 60 megacycles. A frequency modulated signal accordingly appears at the output of oscillator 2. It is apparent that any other convenient system of producing a frequency modulated signal in response to the input wave might be used in place of 1 and 2. This frequency modulated signal is combined in a mixer 3 with the output of an oscillator 4 to produce beat frequencies consisting of the sum and difference of the frequencies from the two oscillators. One of the beat frequencies is selected by means of a filter included in 3, and is then applied to a plurality of amplifiers 5, each of which is tuned to the center of a predeter-

3

mined frequency range or channel. The output of each amplifier is coupled to a corresponding frequency discriminator 6. Any wave energy within the pass band of a given tuned amplifier-discriminator combination will produce a voltage at the discriminator output, which in turn controls the frequency of oscillator 4 by means of reactance tube 7.

Fig. 2 shows in the upper graph a sample group of discriminator curves. The discriminator curve for channel 1, for example, is centered at the resonant frequency of the frequency determining elements of the tuned amplifier 5 in channel 1. In similar fashion the discriminator output characteristics of the remaining channels are centered at the resonance frequency of the corresponding tuned amplifier. The discriminator characteristics are arranged to be contiguous and non-overlapping, as shown in Fig. 2 and to cover the entire range of the selected beat frequency output from the mixer 3. The frequency range for each channel may be adjusted independently so that one channel may cover a range different from other channels. When the frequency of output energy from mixer 3 is such as to lie within the range of channel 1, for example, the discriminator output voltage is applied to the reactance tube so as to control the oscillator 4, so that the mixed frequency is held near the center frequency of channel 1. This automatic frequency control action will remain effective until the discriminator output voltage begins to reverse and can no longer hold the output of the mixer within the pass band of channel 1. Oscillator 4 will then be released and the mixer output will shift suddenly to some other frequency lying in an adjacent or nearby channel dependent upon the input energy to the system. The process will be repeated at the new frequency. The result is that a signal is produced in the output of only one of the channels at a time.

The output of each tuned amplifier 5 is also applied to a corresponding detector 8, which may be a rectifier. The lower part of Fig. 2 shows the rectified voltage output of the corresponding tuned amplifier 7 for each of the channels. As shown in Fig. 1, this rectifier output is taken on separate output lines. Each channel is then applied to any necessary shaping amplifiers 9 and to the utilization apparatus 10.

It is apparent that the above-described system functions equally well to classify pulses in accordance with their amplitudes as it does to quantize a continuously varying signal. The output of the system may be used for any of the purposes mentioned above. In particular, each output may be used to control separate signal generators which produce signals representative of a given amplitude class. Said signal generator may produce simple signals, such as a single pulse having a predetermined characteristic, or complex signals, such as a group of pulses having predetermined characteristics.

While I have described above the principles of my invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example, and not as a limitation to the scope of my invention.

I claim:

1. A selective translator for channelizing a given electrical wave in accordance with its amplitude, comprising a source of electrical oscillations, means for frequency modulating said oscillations in accordance with the amplitude of said wave, a plurality of tuned circuits, each tuned to

4

approximately the center of an associated one of a plurality of contiguous non-overlapping frequency ranges within the range of the frequency modulation of said oscillations, means for coupling the output of said source of electrical oscillations to said circuits, separate automatic frequency control means controlled by the output from each of said circuits for controlling the frequency of the energy applied to said circuits over said associated one of said frequency ranges, and output means connected to each of said circuits.

2. A selective translator according to claim 1 wherein said means for coupling the output of said source of electrical oscillations to said circuits comprise a frequency converter coupled to a second oscillator controlled by said automatic frequency control means.

3. A selective translator for classifying signals in accordance with their amplitudes, comprising a first oscillator, means for frequency modulating the energy of said first oscillator in accordance with the amplitude of said signals, a second oscillator, a combining circuit for mixing the output energy of said first and second oscillators to produce a beat frequency, a plurality of amplifiers each tuned to approximately the center of an associated one of a plurality of contiguous non-overlapping frequency ranges lying within the range of said beat frequency, means for applying said beat frequency to said amplifiers, separate frequency discriminating means coupled to the output of each of said amplifiers for proportioning automatic frequency control voltages, means for controlling the frequency of said second oscillator in accordance with said voltages, a detector connected to the output of each of said amplifiers, and an output circuit for each of said detectors.

4. A selective translator comprising a source of electrical wave energy, a first oscillator, a reactance tube for frequency modulating the energy of said first oscillator in accordance with the amplitude of said wave energy, a second oscillator, a combining circuit for mixing the output energy of said first and second oscillators to produce a beat frequency lying within a predetermined frequency range, a plurality of amplifiers each tuned to approximately the center of an associated one of a plurality of contiguous non-overlapping frequency bands all lying within said predetermined range, means for applying said beat frequency to said amplifiers, a separate frequency discriminator coupled to the output of each of said amplifiers, and having a frequency response characteristic which is substantially linear over said associated one of said frequency bands, and which drops off rapidly outside of said associated one of said frequency bands, a reactance tube for controlling the frequency of said second oscillator in accordance with the output of said frequency discriminators, a coupling between each of said frequency discriminators and said reactance tube, a detector connected to the output of each of said amplifiers, and an output circuit for each of said detectors.

EUGENE COLE.

REFERENCES CITED

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

UNITED STATES PATENTS

Number	Name	Date
2,198,248	Hansell	Apr. 23, 1940