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RADIO RECEIVING SYSTEM

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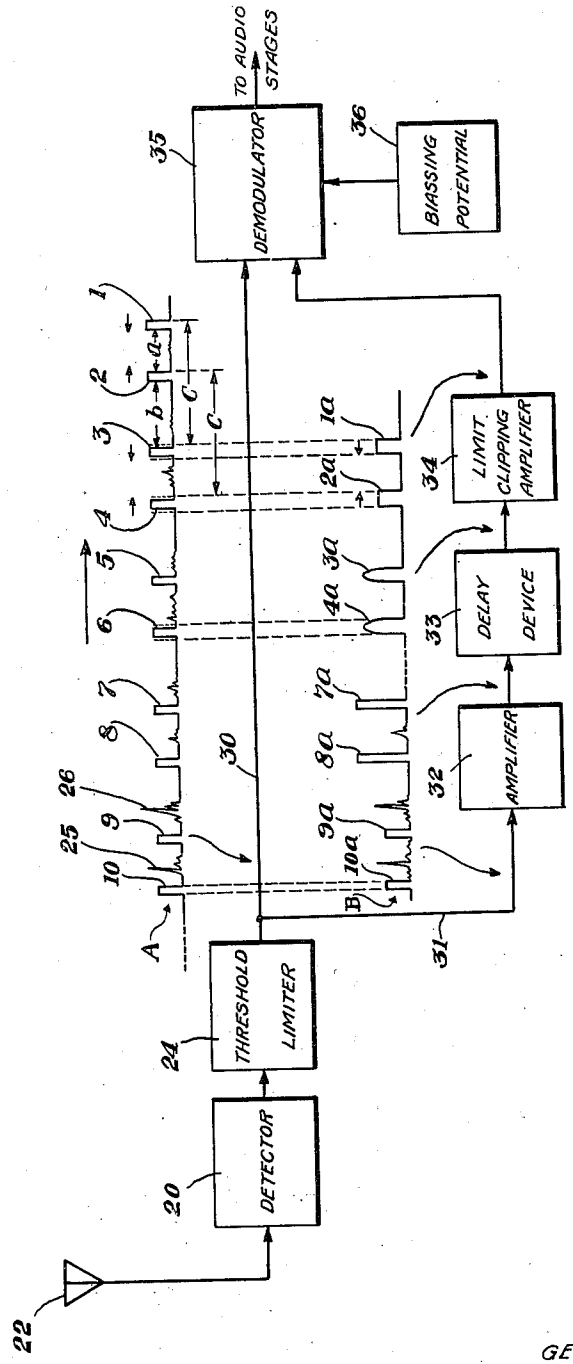

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RADIO RECEIVING SYSTEM

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1 Claim. (Cl. 250—20)

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This invention relates to radio receiving systems and more particularly to a system for receiving waves of time modulated pulses.

It is known that for the reception of electrical energy which is pulse modulated, wherein the pulses occur at substantially equal intervals apart, a receiver which is synchronously blocked and unblocked constitutes an effective protection against high level interference. This synchronous blocking and unblocking is accomplished by use of synchronous resonators which provide regularly timed unblocking pulses for control of the receiving circuit which is normally blocked. This increases the signal-to-noise ratio because the receiving circuit is only unblocked for short intervals corresponding to the approximate timing of pulses, the reception of which is desired. In other words, the receiving circuit is blocked for substantially the duration of the intervals between succeeding pulses thereby eliminating interference occurring during those intervals.

While the prior art systems for controlling the reception of receivers is efficient for waves of time modulated pulses having substantially equal intervals between successive pulses, such systems are not so efficient for receiving "double" or "push-pull" time modulated pulses. This method of time modulation pairs off the pulses in that the time modulation of the pulses of each pair consists generally in the displacement of the two pulses of each pair in opposite directions. That is to say, the pulses of each pair are displaced either toward or away from each other in push-pull manner in accordance with the instantaneous amplitude of the signal energy. When the aforesaid prior art method of blocking and unblocking a receiver circuit is applied to a receiver for reception of push-pull modulated pulses, the unblocking pulse would be displaced at equal intervals apart while the pulses of each pair would be displaced by an interval either greater or less than the interval between the trailing pulse of one pair and the leading pulse of the next succeeding pair. This means that a much wider unblocking pulse is required increased by an amount equal to the difference between the two intervals resulting in a lower signal-to-noise ratio.

It is an object of this invention, therefore, to provide a receiving system with means for improving greatly the signal-to-noise ratio for reception of waves of double or push-pull time modulated pulses.

The above and other objects of the invention will become more clear upon consideration of

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the following detailed description to be read in connection with the accompanying drawing, the sole figure of which shows in block diagram, a receiving system according to the principles of this invention, together with a pair of curves A and B used in explaining the invention.

Referring to the drawing, curve A represents a train of push-pull modulated pulses 1 to 10 which are characteristically grouped in pairs such as pulses 1, 2, 3, 4, 5, 6, etc., according to the push-pull type of modulation disclosed in the copending application of Bac-Bonhomme and myself entitled, "Electrical signalling system employing pulse modulation," Serial No. 491,708, filed June 21, 1943. The pulses of each pair are displaced in opposite directions according to the instantaneous amplitude of the modulating signal energy. The degree of displacement is small compared to the duration of the pulse. The interval between succeeding pulses may be 20 microseconds more or less depending upon the foundation wave and the normal bias, if any, imposed upon the modulator at the transmitter. Should the modulator at the transmitter be normally biased, the pairs of pulses will be spaced apart with the time interval between the trailing pulse of one pair and the leading pulse of the next pair greater than the interval between the two pulses of each pair. This is shown in curve A wherein interval *a* between the pair of pulses 1 and 2 is smaller than the interval *b* between pulses 2 and 3. This particular pulse relationship as well as the dimension of the interval spacings are given by way of example only since both may obviously be widely varied without departing from the invention. For example, where no bias is used, the intervals between succeeding pulses will be equal when the pulses are unmodulated and unequal when some degree of modulation is applied thereto.

The receiver system shown in the drawing includes the usual form of detector 20 which receives pulse modulated carrier wave energy from antenna 22 and translates the energy into current pulses. The output of the detector 20 is applied to a threshold limiter 24 whereby low random noise fluctuations are eliminated. The more pronounced random interference pulses such as 25 and 26, curve A, will be passed by the threshold limiter 24 along with the signal pulses. These random interference pulses, however, are usually entirely eliminated by the system since any two such interference pulses are not likely to be spaced apart according to the

retardation characteristic of the unblocking system.

The output of the threshold limiter **24** applies the train of pulses represented by curve A to parallel circuits **30** and **31** each of which terminates at a known form of demodulator **35**. The circuit **31** includes in series connection an amplifier **32**, a delay device **33** and a limit clipping amplifier **34**. The received pulses such as those illustrated in curve A are applied to the amplifier **32** where they are amplified as indicated by pulses **7***a* and **8***a*. The amplified pulses are fed to the delay device **33** of known character whereby they are retarded an amount preferably equal to the interval *c* which is approximately equal to the sum of the intervals *a* and *b* (curve A). The pulses thus retarded are also increased slightly in duration because of the attenuating characteristics of the delay device. Assuming that the curves A and B have the same time base, the pulse energy of pulses **3** and **4** passing over circuit **31** will appear retarded by an interval *c* as indicated by the positions of pulses **3***a* and **4***a* of curve B. These retarded pulses are limit clipped by amplifier **34** thereby producing rectangular pulses such as indicated at **1***a* and **2***a* corresponding in time with the pulses **3** and **4** transmitted over circuit **30**, also that the pulse energy corresponding to pulses **5** and **6** is at the same moment present within the delay device **33**.

It will be understood that a very large number of pulses are used to define even a small portion of the modulating signal energy so that the difference in displacement of succeeding pulses is very small. Consequently, alternate pulses such as **1** and **3** or **2** and **4** are generally displaced nearly the same amount in the same direction from their unmodulated positions. By retarding energy of pulse **1** by an amount *c* (or an amount slightly under 40 microseconds for the example given) which is substantially equal to the difference in time between pulses **1** and **3**, an unblocking pulse **1***a* is produced which extends in duration sufficient to cover the position of pulse **3**. By regarding pulses **1***a*, **2***a*, **3***a* etc., as the windows for pulses **3**, **4**, **5**, etc., it will be readily understood that these window pulses occur in coincidence with the corresponding signal pulses so that the demodulator will pass the energy of the signal pulses and block interference pulses such as pulses **25** and **26**.

It will thus be understood that the unblocking pulse produced for any signal pulse by the preceding alternate pulse will be time modulated in the same direction and for substantially the same amount that the signal pulse is modulated. Thus, the window or unblocking pulse used according

to my invention is as narrow in width as possible thereby resulting in a very high signal-to-noise ratio.

In sharp contrast to the efficiency of my unblocking invention for the reception of push-pull time modulated pulses is the synchronizing resonators used for producing unblocking pulses at identical intervals apart as heretofore proposed. In order to use such resonator principle in reception of push-pull time modulated pulses, the unblocking pulses must be increased in duration an amount equal to the maximum possible difference in the succeeding intervals between the pulses.

The demodulator **35** is of known form whereby the time modulated pulses are translated into pulses varying in energy according to the time modulation of the signal pulses. The input stage of the demodulator is normally biased by a biasing potential source **36** to block demodulating operation, the unblocking pulse energy **1***a*, **2***a*, **3***a*, etc., operating to overcome sufficiently the blocking bias for proper response to signal pulses for the duration of each unblocking pulse.

While I have shown the principles of my invention in connection with specific apparatus, it is to be understood that the illustrations are given by way of example only and not as limiting the scope of the invention as set forth in the objects and the appended claim.

What is claimed is:

In a system for receiving time modulated pulses of the push-pull modulated character wherein the pulses are paired off with the pulses of each pair generally time displaced in opposite direction according to the instantaneous amplitude of the signal energy, a demodulator, a source of signal pulses, biasing means to render said demodulator normally non-responsive to signal pulses, a first electrical path connecting said source to said demodulator and a second electrical path connecting said source to said demodulator comprising a delay device arranged to extend slightly the duration of the pulses and to retard the pulses an amount substantially equal to the interval separating alternate pulses, an amplifier preceding said delay device to increase the amplitude of pulses before they are applied thereto, a limit clipping amplifier for limiting the amplitude of said retarded pulses so as to give them a substantially rectangular shape and means for applying said retarded pulses to said demodulator to overcome said biasing means and thereby render said demodulator responsive to signal pulses for the duration of each of said retarded pulses.

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