Jan. 4, 1955 H. RINIA 2,698,896

PULSE COMMUNICATION SYSTEM

Filed July 15, 1946 2 Sheets-Sheet 1

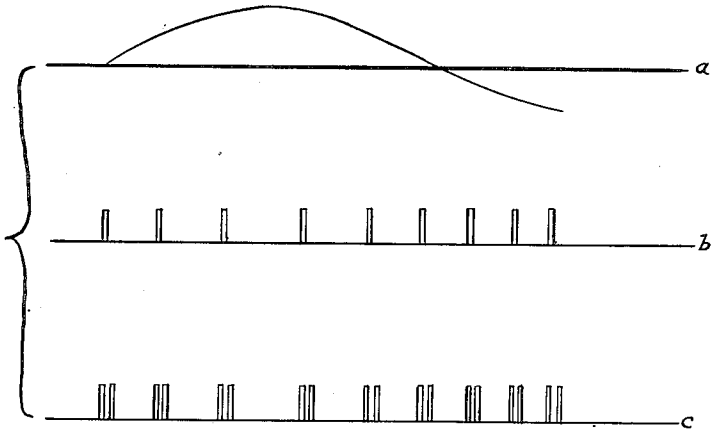

FIG. 1

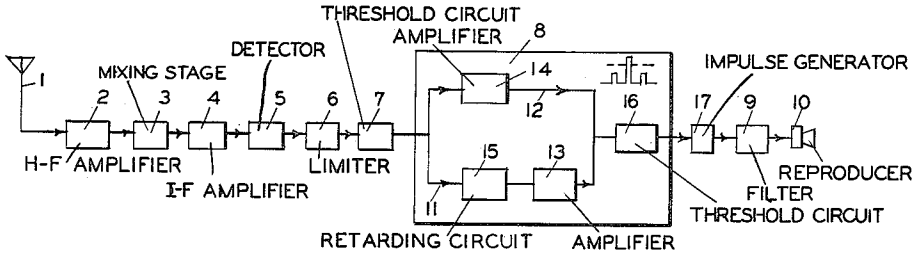

FIG. 2

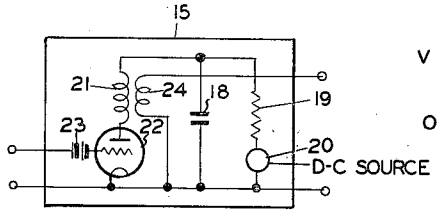

FIG. 3

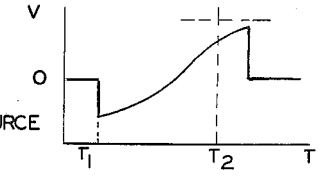

FIG. 4

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PULSE COMMUNICATION SYSTEM

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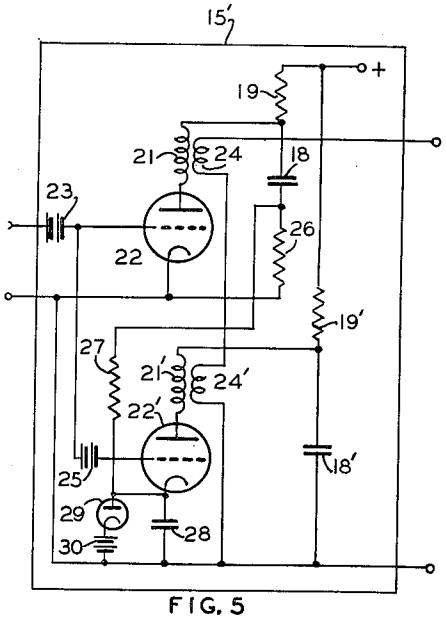

FIG. 5

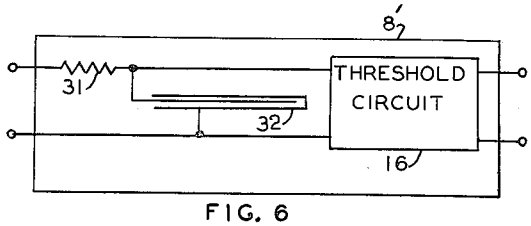

FIG. 6

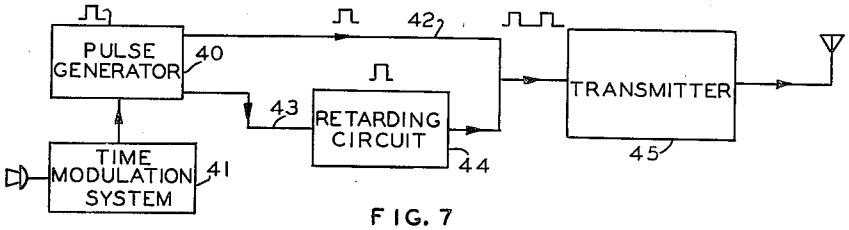

FIG. 7

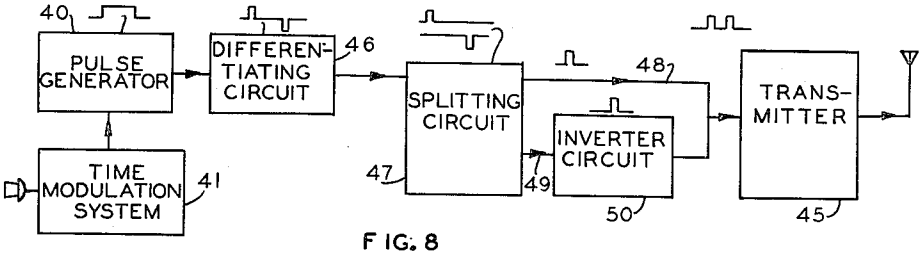

FIG. 8

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2,698,896

PULSE COMMUNICATION SYSTEM

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Application July 15, 1946, Serial No. 683,702
In the Netherlands June 21, 1943

Section 1, Public Law 690, August 8, 1946
Patent expires June 21, 1963

12 Claims. (Cl. 250—6)

It has been proposed to emit signals, more particularly electric currents having a variable intensity, by means of a carrier wave which is modulated by impulses having a constant duration and a variable time character.

Furthermore it has been proposed, in receiving signals thus emitted, to equip the receiving cascade with a device for the production of impulses, which is controlled by the incoming impulses, thus producing in the receiver impulses which are independent of disturbances occurring during the carrier-wave impulses and distorting the amplitude of the impulses, and in addition of disturbances causing a longer duration of the impulse. As a result thereof a favourable signal-to-noise ratio is obtained. The device in question suffers from the drawback, however, that disturbances occurring between the carrier wave impulses are capable of starting up the device for the production of impulses.

According to the invention this drawback is avoided by adding at least one further impulse to each impulse characterizing the signal to be emitted, the character of the impulse combinations thus produced being independent of the signal to be emitted, and by deriving on the receiver side impulses characterizing the signal from the received impulse combinations.

In order that the invention may be clearly understood and readily carried into effect it will now be described more fully with reference to the accompanying drawings, given by way of example, wherein

Fig. 1*a* represents a part of a sinusoidal wave to be transmitted.

Fig. 1*b* illustrates an executional example of the methods already proposed for transmitting, by means of impulses, the signal illustrated in Fig. 1*a*.

Fig. 1*c* illustrates an executional example of the impulse character altered according to the invention as shown in Fig. 1*b*.

Fig. 2 represents one form of construction of the receiving device which is suited for the reception of impulses having the character shown in Fig. 1*c*.

Fig. 3 represents a form of construction of a part of the device shown in Fig. 2, whose operation will be explained by means of the curve represented in Fig. 4.

Figs. 5 and 6 also represent forms of construction of a part of the device shown in Fig. 2.

Figs. 7 and 8 represent embodiments of transmitters according to the invention.

The character of the impulses characterizing the signal to be transmitted and shown in Fig. 1*b*, consists in that the distance between the impulses measured in regard to time, depends on the instantaneous value of the signal to be transmitted. According to the invention a second impulse is added to each impulse characterizing the signal to be transmitted and having the character illustrated in Fig. 1*b*, so that in each instance an impulse combination consisting of two impulses having the same amplitude instead of a single impulse is transmitted. As appears from Fig. 1*c* the amplitude of the impulses and the time interval between the impulses of an impulse combination is independent of the instantaneous value of the signal to be transmitted and preferably the interval between neighbouring impulses of each impulse combination is smaller than and preferably small with respect to the smallest interval between neighbouring impulses characterizing the signal to be transmitted. It is pointed out that the amplitudes of the impulses of an impulse combination need not necessarily be equal and that the number of impulses forming part of an impulse combination and the relative distance between these impulses may be chosen at will. In this manner the character of the impulse combinations can generally be correlated with the effect aimed at, preferably all impulse combinations having the same variation as a function of time, in other words the same time character.

Impulses having the character illustrated in Fig. 1*c* can be obtained by passing the impulses characterizing the signal to be transmitted and shown in Fig. 1*b* through two channels, one of which comprises a retarding circuit whose retarding time corresponds to the desired time interval between the preceding sides of the impulses of an impulse combination, and by combining the impulses appearing in the output circuits of the two channels with the same phase.

An arrangement of this type is illustrated in Fig. 7 wherein a pulse generator **40** provides pulses having a given timing relationship, generator **40** being time-modulated by a system **41** in accordance with the instantaneous amplitude of an intelligence signal. The output of generator **40** is fed to two separate channels **42** and **43**, a retarding circuit **44** being interposed in channel **43** for the purpose of delaying the pulses therein for the desired interval. Channels **42** and **43** have a common output so that for each pulse produced by generator **40** there is formed a double pulse which is applied to radio transmitter **45**, the spacing between the two pulses constituting the double pulse being fixed as determined by the delay characteristic of retarding circuit **44**.

As an alternative impulses having the character illustrated in Fig. 1*c* may be derived from impulses illustrated in Fig. 1*b* by passing the last-mentioned impulses through a differentiating network. In such a network all impulses are converted in each instance into two impulses having opposite polarity. Impulses having the character shown in Fig. 1*c* are obtained by inverting in each instance the polarity of one of these impulses after splitting off from the other impulses and by combining the impulses, whose polarity has been inverted, with the remaining impulses having the same phase.

This embodiment is illustrated in Fig. 8 wherein each time-modulated pulse produced by generator **40** is differentiated by differentiating circuit **46** to form a pair of spaced pulses of opposite sense, the leading pulse thereof corresponding in time with the leading edge of the generated pulse and the trailing pulse corresponding in time with the trailing edge. The pair of pulses thus formed are fed to a splitting circuit **47** which segregates the leading pulse from the trailing pulse. The leading pulse is applied to a channel **48**, and the trailing pulse is applied to a channel **49** incorporating an inverter circuit **50** which reverses the sense of the trailing pulse so that it lies in the same direction as the leading pulse. Channels **48** and **49** have a common output whereby for each pulse yielded by generator **40** there is impressed on transmitter **45** a double pulse, the spacing between the two pulses defining the double pulse being fixed as determined by the width of the generated pulse.

Fig. 2 represents one form of construction of a device for the reception of a carrier wave modulated by impulses having the character shown in Fig. 1*c*.

In this device the carrier-wave impulses picked up by an antenna **1** are supplied to a high-frequency amplifier **2** connected in cascade with a mixing stage **3**, an intermediate-frequency amplifier **4** and a detector **5**. The impulse-shaped voltage obtained after detection and having the character shown in Fig. 1*c* is preferably supplied, through a limiter **6** and a device **7** which only transmits impulses whose amplitude exceeds a definite threshold value, to a device **8** which derives impulses characterizing the signal to be received from the incoming impulse combinations consisting of impulses having a definite time character, said impulses being supplied through a filter **9** to a reproducing device **10**.

The use of the limiter **6** yields the advantage of the device **8** being controlled by impulses having a constant amplitude. The device **7** has the additional advantage of obtaining a greater freedom from disturbances, since this device prevents any disturbances appearing between

the impulses and having a smaller amplitude than the threshold value from being supplied to the device 8.

In the form of construction represented in the drawing the device 8 consists of two parallel branches 11 and 12 each comprising an amplifier or network 13 and 14 respectively for the transmission of impulses, the retardation for the impulses to be transmitted through these branches being different. To secure the desired retardation difference one of the branches, for instance the branch 11, includes a retarding circuit 15. In addition, the device 8 comprises an arrangement with threshold value 16 to which are supplied the impulses transmitted through the two branches with the same phase and combined. The output voltage of the device 16 is supplied to the reproducing device 10.

By a correct adjustment of the preferably variable retardation time of the retarding circuit 15 it can be achieved that the first impulse of each impulse combination of the impulses transmitted through the branch 11 is retarded in such a manner that the retarded first impulse in the input circuit of the device 16 simultaneously appears with the second impulse which forms part of the same impulse combination and is supplied through the branch 12 to the device 16.

When receiving more than two impulse combinations consisting of impulses arranged according to a definite code the retardation time is preferably so chosen that the retarded impulse derived, for instance from the first impulse, appears simultaneously with the last impulse forming part of the same impulse combination. In this way impulses are generally derived from the incoming impulses, which are so retarded as to appear simultaneously with impulses forming part of the same impulse combination and following the impulses from which the retarded impulses have been derived.

After combination in the same phase of the impulses transmitted through the two branches a combined signal is consequently obtained whose variation for an impulse combination is illustrated in the drawing, of which signal each impulse combination comprises one impulse having a larger amplitude than the remaining impulses. The device with threshold value 16 separates the impulses, whose amplitude exceeds that of the remaining impulses, from the other impulses so that per impulse combination one impulse, viz. the second impulse, is supplied to the reproducing device 10.

Since the interval between the impulses in question depends on the instantaneous value of the signal to be transmitted this signal can be derived in a well-known manner from these impulses characterizing the signal.

The conversion of the impulses having a constant amplitude and a variable duration, which characterize the signal to be transmitted and are supplied to the reproducing device 10, into a current having a variable intensity may take place by supplying these impulses through the filter 9, which suppresses the alternating current component, to the reproducing device 10 e. g. a loudspeaker.

Since the device 8 supplies only one impulse to the reproducing device 10 if two impulses having a definite amplitude simultaneously appear in the input circuit of the device 16, the device 8 (hereinafter called impulse-dividing device) is practically insensitive to all disturbances appearing between the impulse combinations. If the interval between two undesired impulses corresponds to the difference in time delay between the branches 11 and 12 there is a risk of the signal appearing in the reproducing device being disturbed by these signals. In practice, however, such a case will seldom occur, so that the device set out above permits a reception which is practically free from disturbances.

In the device represented in Fig. 2 a device for producing impulses 17 is preferably interposed between the device 8 and the reproducing device 10 in the receiving cascade, which device controls the impulses given off by the impulse dividing device. In this case impulses are generated in the receiver itself, whose amplitude and duration are entirely independent of the amplitude and duration of the incoming impulses, so that disturbances distorting the amplitude and increasing the duration do not affect the reproducing device. However, the interval between the impulses produced in the receiver is determined by the interval between the impulses emitted by the impulse dividing device 8, so that the interval between the impulses supplied to the reproducing device exactly corresponds to the instantaneous value of the signal to be received.

In the device shown in Fig. 2 the retarding circuit may be a filter circuit.

One form of construction of a retarding circuit, in which use is made of a gas-filled discharge tube, is shown in Fig. 3. In this form of construction the retarding circuit consists of a condenser 18 which is rapidly charged through a resistance 19 by a source of direct current 20 and is capable of discharging through the series connection of an inductance 21 and a gas-filled discharge tube 22. The tube 22 is normally blocked by means of a source of negative grid bias 23. If, however, an impulse-shaped voltage originating from the first impulse of an impulse combination is supplied to the tube 22 this tube becomes conductive as a result of which the condenser 18 discharges through the series connection of the inductance 21 and the tube 22. The discharge current of the condenser 18 involves an impulse shaped voltage through an inductance 24 coupled with the inductance 21, whose variation is represented as a function of time in Fig. 4. In this figure t_1 denotes the moment at which the first impulse of an impulse combination initiates the condenser discharge, t_2 denoting the moment at which the second impulse of the impulse combination is supplied to the grid of the tube 22. On the appearance of the second impulse, however, the tube 22 is already conductive so that this impulse does not involve a voltage through the coil 24. On receiving an impulse combination an impulse-shaped voltage, whose variation is illustrated in Fig. 4, may consequently be derived from the discharge circuit of the condenser 18 by means of the inductance 24.

As appears from Fig. 4 the positive voltage impulse appearing across the inductance 24 is retarded with respect to the first impulse supplied to the tube 22. By correlating the discharge time of the condenser 18 with the time interval between the impulses it can be achieved that the second impulse of each impulse combination, which is supplied through the branch 12 to the device 16, appears simultaneously with the impulse-shaped voltage whose curve is shaped as represented in Fig. 4, which voltage appears through the inductance 24 and is produced in a retarded manner by the first impulse. The simultaneous appearance of the said impulses with a combination having the same phase results in that each impulse combination comprises an impulse having an amplitude exceeding the threshold value of the device 16, which impulse is supplied to the reproducing device 10. In Fig. 4 the threshold value of the device 16 is represented by the dotted horizontal line.

When making use of the aforesaid retarding circuit, in which use is made of a gas-filled discharge tube, there is a risk, on receiving a disturbance just before receiving an impulse combination, of the impulse combination in question being lost. This occurs, for instance, if the duration between the disturbance and the first impulse of an impulse combination is smaller than the interval between the impulses to be received. In this case, in effect, the disturbance initiates the discharge of the condenser 18, and the first impulse of the impulse combination appears at the grid of the tube 22 at a moment at which the tube 22 is already conductive. Consequently, this impulse will not involve a voltage across the resistance 24. A voltage impulse brought about by the disturbance will appear across the inductance 24 and also the second impulse of the impulse combination produces a voltage impulse across the inductance 24, it is true, but these two impulses will not appear simultaneously with the second impulse of the impulse combination supplied through the branch 12 to the device 16, so that no voltage impulse is supplied to the reproducing device.

To avoid this drawback use may be made of the retarding circuit shown in Fig. 5.

The retarding circuit 15' represented in Fig. 5 consists of two devices, as represented in Fig. 3, each comprising a condenser 18 and 18' respectively, which are rapidly charged through a resistance 19 and 19' respectively by a source of potential 20 and is capable of discharging through the series connection of an inductance 21 and 21' respectively and a gas-filled discharge tube 22 and 22' respectively. The incoming impulses are supplied in phase to the grids of the tubes 22 and 22'. The output voltage of the device is taken from the series-connected coils 24 and 24' coupled with coils 21 and 21' respectively. To the grid of the tube 22 is supplied a negative voltage from the voltage source 23, whereas the grid of the tube 22' receives a negative voltage from the voltage sources 23 and 25. Furthermore no terminal of

a resistance 26 inserted in the discharge circuit of the condenser 18 is connected, through a resistance 27, to the cathode of the tube 22', the cathode lead of the tube 22' including a condenser 28 which is shunted by the series connection of a diode 29 and a voltage source 30.

When in the aforesaid circuit arrangement the first impulse of an impulse combination is supplied to the grids of the tubes 22 and 22' the tube 22 becomes conductive, whereas the tube 22' remains blocked by the voltage source 25. Consequently, the first impulse involves a discharge of the condenser 18, as a result of which a voltage impulse, whose curve is shaped as shown in Fig. 4, appears across the inductance 24, which impulse appears simultaneously with the second impulse of the impulse combination transmitted through the branch 12 (Fig. 2) if the discharge time of the condenser 18 is correlated with the time interval between the incoming impulses of an impulse combination. This results in that on receiving an impulse combination the second impulse is supplied to the reproducing device.

If, however, a disturbance appearing before the first impulse brings about a discharge of the condenser 18, the device 18 to 22 is insensitive to the next first impulse of an impulse combination so that the impulse combination in question would be lost. This is avoided by the device 18' to 22' which essentially corresponds to the device 18 to 22. To the device 18' to 22' is supplied such a bias from the voltage source 25 that the incoming impulses alone cannot bring about a discharge of the condenser 18'. During the discharge of the condenser 18, however, a voltage is set up across the resistance 26 in the discharge circuit of the condenser, which voltage is supplied through the resistance 27 to the condenser 28 and appears with a positive polarity at the grid of tube 22'. The voltage set up across the condenser 28 is limited by means of the diode 29 and the voltage source 30 to such a value that, as long as this voltage subsists, the incoming impulses are capable of bringing about a discharge of the condenser 18'. Consequently, the device 18' to 22' is exclusively sensitive during the discharge time of the condenser 18, during which time the device 18 to 22 is insensitive.

Upon reception of a disturbance preceding the first impulse of the impulse combination, by which disturbance the device 18 to 22 is rendered insensitive to the first impulse, the device 18' to 22' will be able to become operative during the discharge time of the condenser 18 at the moment at which the first impulse of an impulse combination is supplied to the grid of the tube 22'. Consequently, the first impulse of the impulse combination involves a discharge of the condenser 18' and as a result thereof a voltage impulse through the coil 24', which impulse appears simultaneously with the second impulse transmitted along the branch 12. Consequently, on reception of an impulse combination an impulse, and more particularly the second impulse of an impulse combination, is supplied to the reproducing device despite the preceding disturbance.

It is pointed out that the size of the condenser 28 and the resistance 27 are so chosen that the voltage across the condenser 28 is not set up before the end of the impulse bringing about the discharge of the condenser 18. In this way it is avoided that the device 18' to 22' is sensitive already during the appearance of the disturbing impulse supplied to the grid, so that this impulse disturbs both the operation of the device 18' to 22' and that of the device 18 to 22.

Fig. 6 represents a simplified form of construction of the impulse dividing device 8 shown in Fig. 2. By the device 8' the incoming impulses are supplied directly to the device 16 through a resistance 31. Moreover, the incoming impulses are supplied to a cable 32 consisting of two concentric conductors. At the end of the cable the impulses are reflected and the reflected impulses, which are consequently retarded with respect to the incoming impulses, are likewise supplied to the device 16. Similarly to the aforesaid devices 8 a judicious correlation of the retardation time and the time interval between the incoming impulses permits at least two impulses of an impulse combination to be simultaneously supplied to the device 16, as a result of which one impulse per impulse combination appears in the output circuit of the device 16.

The retardation time of the device 8 is preferably adjustable which permits the receiver to be adapted to the time interval between the impulses of an impulse combination, which may be different for various transmitters.

What I claim is:

1. Apparatus for transmitting an intelligence signal comprising means to generate impulses having a given timing relationship, means to time-modulate said impulses in accordance with the instantaneous amplitude of said signal, separate first and second channels for conducting said time-modulated impulses, one of said channels including a retarding circuit for delaying the impulses therein a predetermined interval, means for combining the outputs of said first and second channel so that each of said impulses is represented by a double pulse thereby forming a train of time-modulated double pulses, and means to transmit said train as a modulation component on a radio frequency carrier.

2. Apparatus for transmitting an intelligence signal comprising means to generate impulses having a given timing relationship, means to time-modulate said impulses in accordance with the instantaneous amplitude of said signal, means to differentiate said time-modulated impulses to produce leading and trailing spaced pulses of opposite sense, means to segregate said leading and trailing pulses, means to invert said trailing pulses, means to combine said leading pulses with said inverted trailing pulses to form a train of time-modulated double pulses, and means to transmit said train as a modulation component on a radio frequency carrier.

3. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising means to detect said train of double pulses, separate first and second channels for conducting the detected double pulses, said first channel including retarding means for delaying the detected double pulses therein for an interval equal to said fixed spacing, and means to combine the leading pulse of each of the double pulses in said first channel with the trailing pulse of each of the double pulses in said second channel to form an output pulse whose amplitude is equal to the sum of said leading and trailing pulses.

4. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising means to detect said train of double pulses, separate first and second channels for conducting the detected double pulses, one of said channels including retarding means for delaying the detected double pulses therein for an interval equal to said fixed spacing, means to combine the output of said first and second channels to form triple pulses whose middle pulse has an amplitude equal to the sum of two individual pulses, and means to separate said middle pulse from said triple pulse whereby a train of time-modulated middle pulses is produced enabling demodulation of said signal.

5. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising means to detect said train of double pulses, separate first and second channels for conducting the detected double pulses, one of said channels including retarding means for delaying the detected double pulses therein for an interval equal to said fixed spacing, means to combine the output of said first and second channels to form triple pulses whose middle pulse has an amplitude equal to the sum of two individual pulses, a threshold amplifier responsive solely to input voltages having an amplitude at least equal to the amplitude of said middle pulse for producing a train of time-modulated output pulses.

6. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising means to detect said train of double pulses, separate first and second channels for conducting the detected double pulses, one of said channels including retarding means for delaying the detected double pulses therein for an interval equal to said fixed spacing, means to combine the output of said

first and second channels to form triple pulses whose middle pulse has an amplitude equal to the sum of two individual pulses, a threshold amplifier responsive solely to input voltages having an amplitude at least equal to the amplitude of said middle pulse for producing a train of time-modulated output pulses, a pulse generator providing impulses of fixed duration and constant amplitude, and means to synchronize the timing of said generator in accordance with said output pulses.

7. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising a detector for said train of double pulses, a limiter connected to the output of said detector for limiting the amplitude of the detected double pulses to a predetermined value, separate first and second channels coupled to the output of said limiter for conducting the limited double pulses, said first channel including a retarding circuit delaying the limited double pulses therein for an interval equal to said fixed spacing, common output means to combine the outputs of said first and second channels to form triple pulses whose middle pulse has an amplitude equal to the sum of the leading pulse of the double pulse in said first channel and the trailing pulse of the double pulse in said second channel, a threshold amplifier coupled to said common output means and responsive solely to an input voltage having an amplitude at least equal to the amplitude of said middle pulse thereby producing a train of time-modulated middle pulses, a pulse generator providing impulses of fixed duration and constant amplitude, and means to synchronize the timing of said generator in accordance with said train of middle pulses.

8. Apparatus for receiving a train of high-frequency double pulses time-modulated in accordance with the instantaneous amplitude of an intelligence signal, each double pulse being constituted by a pair of pulses having a fixed spacing, said apparatus comprising a detector for said train of double pulses, a limiter connected to the output of said detector for limiting the amplitude of the detected double pulses to a predetermined value, separate first and second channels coupled to the output of said limiter for conducting the limited double pulses, said first channel including a retarding circuit delaying the limited double pulses therein for an interval equal to said fixed spacing, common output means to combine the outputs of said first and second channels to form triple pulses whose middle pulse has an amplitude equal to the sum of the leading pulse of the double pulse in said first channel and the trailing pulse of the double pulse in said second channel, a threshold amplifier coupled to said common output means and responsive solely to an input voltage having an amplitude at least equal to the amplitude of said middle pulse thereby producing a train of time-modulated middle pulses, a pulse generator providing impulses of fixed duration and constant amplitude, means to synchronize the timing of said generator in accordance with said train of middle pulses, means to demodulate the time-modulated impulses of said generator to produce energy amplitude-modulated in accordance with said signal, and reproducing means responsive to said amplitude-modulated energy.

9. In a communication system of the type in which signal characteristics are represented by a series of first impulses modulated to represent the signal characteristics, said first impulses being spaced apart in time a large amount with respect to their duration, an arrangement for reducing the disturbing effects of interfering impulses comprising means for producing from each of said first impulses at least two indicating impulses spaced apart in time by a fixed time interval which is small with respect to the spacing of said first impulses, receiver means for receiving said indicating impulses, and discriminator means in said receiver means for discriminating between impulses spaced apart by said fixed time interval and all other impulses, whereby only said spaced impulses may be used for signal indications, said discriminator means comprising first and second paths for said received impulses, blocking means normally blocking said first path so that signals cannot pass, delay means in said second path for delaying impulses by an amount equal to said fixed time interval, and means for applying said delayed impulses to said blocking means to permit passage of impulses over said first path during the time of application of each delayed impulse.

10. In a communication system of the type in which signal characteristics are represented by a series of first impulses modulated to represent the signal characteristics, said first impulses being spaced apart in time a large amount with respect to their duration, an arrangement for reducing the disturbing effects of interfering impulses comprising means for producing from each of said first impulses at least two indicating impulses spaced apart in time by a fixed time interval which is small with respect to the spacing of said first impulses, receiver means for receiving said indicating impulses, and discriminator means in said receiver means for discriminating between impulses spaced apart by said fixed time interval and all other impulses, whereby only said spaced impulses may be used for signal indications, the means for producing two indicating impulses from each first impulse comprising two branch circuits, delay means having a delay equal to said fixed delay in one branch circuit, means for applying said first impulses to said two branch circuits, and common output means for said two branch circuits in which are developed impulses from both branches.

11. A receiver system for receiving pairs of impulses spaced apart a predetermined amount in time, each pair representing an increment of modulating signal energy in a modulated wave, means for receiving said pairs of impulses, discriminating means in said receiver for discriminating between pairs of impulses separated by said predetermined time delay and all other impulses, and translator means coupled to said discriminating means for reproducing the original modulating signal of said modulated wave, said discriminator means comprising first and second receiver paths for said received impulses, blocking means normally blocking said first receiver path so that signals cannot pass, delay means in said second receiver path for delaying impulses by said predetermined amount, and means for applying said delayed impulses to said blocking means to permit passage of impulses over said first receiver path during the time of application of each delayed impulse.

12. In a communication system of the type in which signal characteristics are represented by first impulses modulated to represent the signal characteristic, a method of reducing the disturbing effect of interfering impulses which comprises producing from each of said first impulses at least two indicating impulses spaced apart by a fixed time interval which is small relative to the normal time spacing of said first impulses, receiving said indicating impulses, and discriminating between impulses spaced by said fixed time interval and other impulses by transferring said received impulses over first and second paths, delaying said impulses in said second path by a time equal to said first time interval and applying said delayed impulses from said second path to said first path to render said first path conductive only during application of impulses from said second path.

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