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PERIODIC WAVE REPEATER

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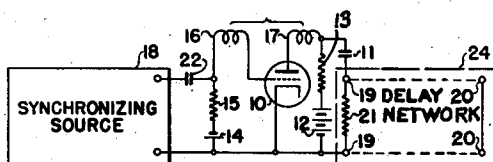


FIG. 1.

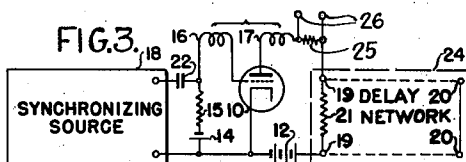


FIG. 3.

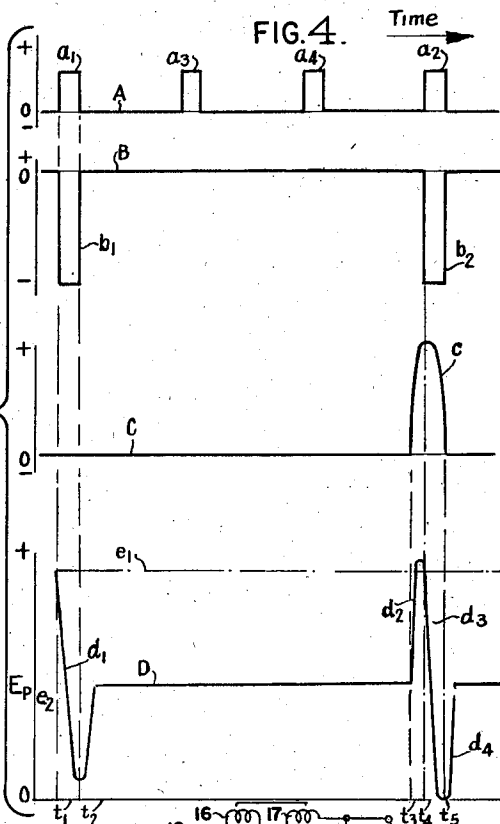
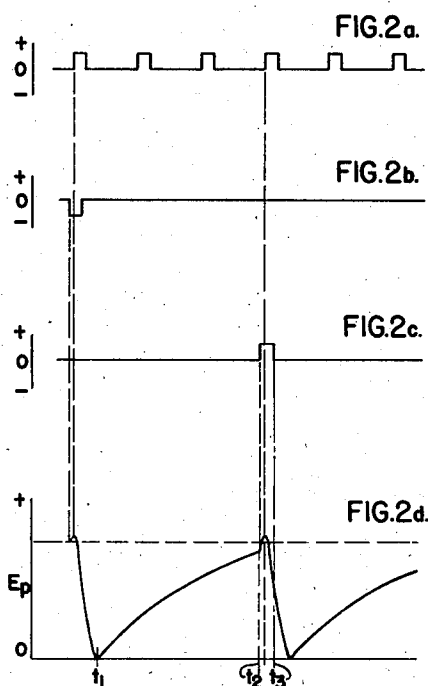


FIG. 4.

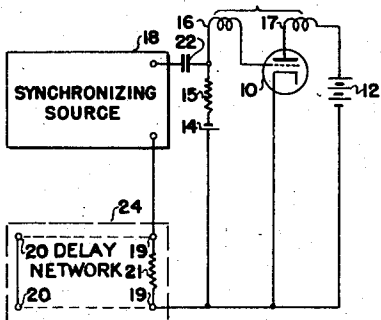


FIG. 5.

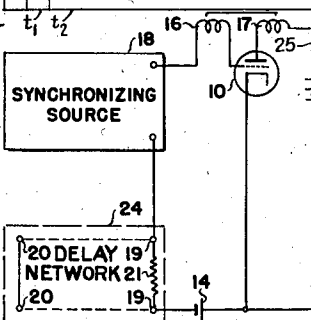


FIG. 6.

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PERIODIC WAVE REPEATER

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18 Claims. (Cl. 250—36)

This invention relates to periodic wave repeaters and more particularly to such repeaters which are substantially insensitive to undesired control pulses or to extraneous transients during the greater portion of each period intervening between successive output pulses.

In many applications of periodic wave repeaters, it is essential that the repeater be extremely stable in operation and that the occurrence of the periodic pulses be precisely timed in phase and frequency with respect to a reference or controlling standard. It has heretofore been proposed to improve the stability of such repeaters by reducing to a minimum the portion of the cycle during which the repeater is sensitive to a control influence, thus reducing the chances that it will be triggered by extraneous transients or undesired control pulses to produce a spurious output pulse. One embodiment of this feature is disclosed and claimed in a copending application of Harold A. Wheeler and John C. Wilson, Serial No. 236,200, filed October 21, 1938, in which the repeater is normally maintained insensitive and is sensitized by means of a delay-filter network or transmission line which feeds back delayed pulses from the output circuit of the repeater to the sensitivity-controlling circuit to determine the successive output pulses. Such an arrangement has the advantage of an extreme accuracy in determining the interval separating successive pulses which cannot be obtained by many timing circuits, for example, those including resistance the impedance value of which changes with temperature and other operating conditions.

The present invention constitutes an improvement on the periodic wave repeater of the type described and claimed in the above-mentioned application of Wheeler and Wilson in which the timing-delay network is not included in a feedback path from the output circuit to the sensitivity-controlling circuit of the repeater but is individual to the sensitivity-controlling circuit. While the improved periodic wave repeater of the invention is of general application, it is particularly useful as a submultiple-frequency generator for use in the timer of a television signal generator, as a synchronizing-signal separator for a television receiver, and as a relaxation oscillator, per se.

It is an object of the invention, therefore, to provide an improved periodic wave repeater in which the time constant of the timing circuit depends on stable electrical quantities.

It is a further object of the invention to pro-

vide an improved periodic wave repeater in which the period thereof is dependent solely on an electrical-delay network as distinguished from a concentrated resonant circuit or a dissipative time constant circuit.

It is a further object of the invention to provide an improved periodic wave repeater the operation and period of which are dependent solely upon predetermined pulses which may be selected from a series of pulses and disturbances such as static.

It is an object of the invention, therefore, to provide an improved pulse wave repeater for producing output pulses which are precisely timed by one edge of only selected pulses of an input-timing pulse signal.

It is a more specific object of the invention to provide a pulse wave repeater in which a delayed derived pulse and an undelayed input pulse cooperate in such manner that the initiation of an output pulse is responsive solely to the leading edge of such undelayed input signal.

It is a further object of the invention to provide an improved submultiple generator or frequency divider which is insensitive except during predetermined intervals determined by a delay network, the timing of which depends mainly on stable capacitance and inductance values as distinguished from unstable resistance values.

In accordance with a feature of the invention, a periodic wave repeater for producing periodic output pulses comprises a repeater device having an input circuit and an output circuit, one of the circuits constituting a sensitivity-controlling circuit. An electrical-delay network is provided which has a plurality of terminals between which there is effectively a time delay approximately equal to the desired period of the output pulses of the repeater. Means are also provided so coupling the terminals of the delay network to the sensitivity-controlling circuit that the delay network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such a delay and with such polarity as to sensitize said repeater at the time the succeeding output pulse from said repeater is due. In a preferred embodiment of the invention, the repeater comprises a vacuum tube adapted to produce relaxation oscillations.

In accordance with a further feature of the invention, a pulse-wave repeater stage for producing output pulses comprises a repeater device having input and output circuits, one of which is

adapted to have applied thereto a signal including a pair of pulses with predetermined time separation. Means are included in the repeater device and its associated circuits for maintaining the stage normally insensitive to the above-mentioned pulses alone. Means are further provided for deriving from the first pulse of the pair a pulse delayed for a time less than the above-mentioned predetermined time and having a duration such that it coincides in time with the second pulse of the pair for a predetermined interval, together with means including the repeater device responsive jointly to the delayed pulse and to the above-mentioned second pulse for deriving an output pulse only during the above-mentioned predetermined interval.

As used in this specification, the term "delay network" is defined as one in which the time delay of a narrow pulse transmitted through the network is at least twice as great as the broadening of the pulse by the network, the time delay being measured as the time interval between the transmitted pulse in the input circuit and the peak of the pulse in the output circuit of the network, and the broadening effect being measured as the increase in the time duration of the output pulse at half the peak amplitude caused by its transmission through the network. In a wave filter made up of lumped reactance elements, several sections are necessary to provide a "delay network."

In accordance with a preferred embodiment of the invention, synchronizing pulses are also applied to the input circuit of the wave generator and the time at which the generator is triggered to produce an output pulse is dependent upon the joint occurrence of the synchronizing pulse and the delayed pulse from the delay network. In the absence of either of these two pulses, therefore, the generator is maintained inoperative to produce output pulses. In a modified form of the invention, the synchronizing circuit may be omitted and the period of the generator may be controlled solely by the precisely timed pulses which are applied to the sensitivity-controlling circuit of the generator from the delay network.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the drawing, Figs. 1, 3, 5, and 6 are circuit diagrams, partially schematic, of different embodiments of the invention; Figs. 2a-2d illustrate certain operating characteristics of the circuit of Fig. 1, and Fig. 4 illustrates certain operating characteristics of the circuit of Fig. 3.

Referring now more particularly to the drawing, in Fig. 1 there is shown a relaxation oscillator which is timed by a reflected pulse derived from a line or filter network operating as a delay network. The relaxation oscillator comprises a vacuum tube 10 connected to discharge periodically and rapidly a condenser 11 which is slowly charged between successive discharges from a direct current supply circuit comprising a suitable source, such as a battery 12, and a resistor 13. Vacuum tube 10 has a control grid which is normally biased partially or completely to cutoff by an input circuit including a bias source, such as a battery 14 and a resistor 15. In order that the circuit of Fig. 1, comprising a high vacuum tube 10, may operate as a conventional relaxa-

tion oscillator, there is provided a feed-back coupling comprising an inductor 16 in the input circuit of tube 10 inductively coupled to an inductor 17 in the output circuit thereof, though it will be understood that this feed-back circuit may be omitted in case a vapor or gaseous electron-discharge tube is utilized. Synchronizing signals may be applied to the input circuit of vacuum tube 10 from a suitable source 18 through coupling condenser 22. A delay network 24 is included in the output circuit, which is the sensitivity-controlling circuit of the system of Fig. 1. This delay network may be a uniform transmission line, a uniform artificial line, or a wave filter composed of lumped reactance elements, and is shown as a simple uniform transmission line having input terminals 19, 19 and junction terminals 20, 20 remote from input terminals 19. The transmission line is terminated in its image impedance by means of resistor 21 at input terminals 19 and is terminated at junction terminals 20 in an impedance much less than its normal image impedance at junction terminals 20 to provide a two-terminal voltage-reversing reflecting filter. As shown in the drawing, junction terminals 20 are short-circuited. Terminals 19 are connected in series with condenser 11 in the output, or sensitivity-controlling circuit, of vacuum tube 10.

Reference is made to Figs. 2a-2d for an explanation of the operation of the circuit of Fig. 1. Fig. 2a represents a synchronizing signal having one or several pulses per output cycle, three being shown as an example. In case the synchronizing signal of Fig. 2a is utilized, the device operates as a frequency divider by synchronizing at a sub-multiple frequency. Fig. 2b shows the starting pulse of current in the output circuit of tube 10 which may be initiated by momentarily decreasing the negative grid bias of battery 14 during the occurrence of a synchronizing pulse. This pulse is built up by the feedback through inductors 16, 17 of the relaxation oscillator and is quickly chopped off by the discharging of the condenser 11. The pulse of current of Fig. 2b flowing through condenser 11 and resistor 21 causes a voltage pulse of negative polarity to travel down the transmission line 24 toward junction terminals 20 and to be reflected after a predetermined time delay with opposite polarity. Fig. 2c shows the later arrival of the reflected pulse of Fig. 2b at terminals 19 of network 24. Immediately after the pulse of Fig. 2b, that is at time t_1 , condenser 11 begins to charge as shown by the anode potential-time characteristic of Fig. 2d. The dotted line of Fig. 2d represents the critical anode potential at which the tube 10 becomes conductive with a synchronizing pulse applied to its grid-cathode circuit.

The characteristic of Fig. 2d, during the time interval t_2-t_3 when the reflected positive pulse from terminals 19 is injected into the output or sensitivity-controlling circuit, indicates that the tube will be fired during this interval if a synchronizing pulse simultaneously occurs during the interval. The time delay of delay network 24 is made to be only slightly smaller than the period of the synchronizing pulses by which it is desired to control the oscillations. Under these conditions, it will be understood that each firing of the tube 10 is determined precisely by the instant at which a pulse of Fig. 2a is applied to its input circuit and a positive pulse of Fig. 2c occurs in its output circuit. Immediately after firing, a negative pulse is developed across ter-

minals 19, this negative pulse travelling forward and backward through delay network 24 and appearing as a positive pulse at terminals 19 to initiate the next firing of tube 10. Since the delay of line 24 is very slightly less than the period of the synchronizing pulses, it will be seen that vacuum tube 10 is maintained nonconductive over the greater portion of the operating cycle and is conditioned for operation by a pulse applied from the delay network 24 in each instance just in time for the occurrence of the desired synchronizing pulse in the input circuit of the tube 10, thereby rendering the periodic wave generator insensitive to undesired controlling influences until the time it is desired to effect operation by a selected synchronizing pulse.

It will be understood that the source of synchronizing signals 18 may be omitted, in which case the periodicity of the wave generator of Fig. 1 is controlled solely by the time delay of line 24. Furthermore, the circuit may be so adjusted that, even in the absence of a reflected pulse, corresponding to that of Fig. 2c, the output voltage would eventually rise above the level of the dotted line of Fig. 2d. Under these conditions the circuit is self-starting after a failure to fire due, for instance, to interference just at the time the circuit would ordinarily fire.

The periodic wave generator of Fig. 3 is essentially similar to that of Fig. 1 and similar circuit elements have been given identical reference numerals. The circuit of Fig. 3 differs from that of Fig. 1 primarily in that condenser 11, which is the principal anode voltage-determining element in the circuit of Fig. 1, has been omitted in the circuit of Fig. 3. Thus, the potential across terminals 19 of delay network 24 in the circuit of Fig. 3 becomes substantially the sole factor in determining the variations of the anode voltage of tube 10 about its mean value which is the voltage of battery 12. Output terminals 26, 26 coupled across a resistor 25 in the anode circuit of tube 10 are also provided in the circuit of Fig. 3. It will be understood that the output means including coupling resistor 25 and output terminals 26, 26 is of a type well known in the art and that no novelty is claimed therefor either alone or in combination with other elements of the repeater circuit.

In considering the operation of the wave repeater of Fig. 3, reference is made to Fig. 4 in which curve A represents a periodic-pulse input wave supplied by source 18; curve B, the pulse current wave developed in the output circuit of tube 10, which is similar to the pulse voltage wave developed across the input terminals 19, 19 of delay network 24; curve C, the delayed reflected voltage pulse wave appearing across the input terminals 19, 19 of the delay network; and curve D the anode-voltage time characteristic of the repeater tube 10. Assuming that, at instant t'_1 , the anode voltage of tube 10 is at a value e_1 such that the tube is fired by an input pulse a_1 from source 18 applied to its input circuit, a negative voltage pulse b_1 is generated across the input terminals 19, 19 due to the output current of similar wave form flowing through resistor 21 in the time interval $t'_1-t'_2$ accompanied by a rapid fall of anode potential d_1 . Such negative voltage pulse b_1 is translated by the network 24 and reflected from its remote junction terminals 20, 20 with opposite polarity as a delayed positive voltage pulse c appearing across terminals 19, 19 after a delay $t'_1-t'_3$, which is slightly less than the predetermined time $t'_1-t'_4$ of separation

between a pair of selected pulses a_1 and a_2 of the periodic-input pulse wave of curve A. The delayed positive voltage pulse c , due to an unavoidable widening or degrading effect of the network 24, has a duration $t'_3-t'_5$ such that it coincides in time with the second pulse a_2 for a predetermined interval $t'_4-t'_5$ during which time the tube 10 is again fired by the second input pulse a_2 applied to its grid to repeat the cycle. Output voltage pulses corresponding to the output current pulses b_1, b_2 are developed across the coupling resistor 25 and appear at the output terminals 26, 26. There is no reflection of the delayed voltage pulse c at the terminals 19, 19 of the delay network 24 because the impedance of the resistor 21 substantially matches its image impedance.

During the time $t'_2-t'_3$, the anode potential D of the output circuit does not rise above the steady state value e_2 of battery 12 which is so related to the grid bias derived from battery 14 that the tube 10 is entirely insensitive to all input pulses including nonselected pulses a_3, a_4 of the input pulse wave of curve A intervening between the selected pair of pulses a_1, a_2 . However, at the instant t'_3 the delayed positive pulse c is applied to the output circuit so that the anode potential rises rapidly at d_2 and the tube is in a condition to be fired at instant t'_4 by the leading edge of the selected second input pulse a_2 to produce the desired output pulse initiating precisely at the time t'_4 and persisting during the interval $t'_4-t'_5$ in which the tube 10 is conductive. The anode potential during this interval $t'_4-t'_5$ falls rapidly at d_3 below the normal anode potential e_2 due to the feed-back coupling 16, 17 between the input and output circuits. The anode potential then returns to its normal value due to the discharge current developed by the collapse of the magnetic field of windings 16, 17 which flows into the inherent capacitance of the output circuit either gradually or rapidly, as indicated at d_4 , depending upon the circuit constants.

It will be noted that the reflected voltage pulse c is not only somewhat widened but that it is also somewhat degraded due to the fact that the transmission characteristics of delay network 24 are not ideal. Therefore, the leading edge of the reflected voltage pulse is not as steep nor as precisely timed as the corresponding edge of the input pulse. In accordance with the invention, by making the delay of filter network 24 slightly less than the time separation of successive input pulses, the tube 10 is conditioned to fire only upon the leading edge of the original input pulse and is thus nearly independent of the transmission properties of the delay network.

From a consideration of the circuit of Fig. 1, it will be seen that resistor 13 and condenser 11 are utilized as a circuit to provide an approximate time constant for the operation of the system. It will also be understood that resistor 15 and grid condenser 22 also have an effect upon the operation of the system of Fig. 1 but that the operation of Fig. 1 may be as above described if resistor 13 and condenser 11 are so proportioned as to be controlling factors in the circuit. The circuit of Fig. 5 is generally similar to that of Fig. 1 and similar circuit elements have been given identical reference numerals. The primary difference in the circuit of Fig. 5 and that of Fig. 1 is that the elements 13 and 11 have been omitted and resistor 15 and condenser 22 are made to be the time-constant-determining elements. Also in the circuit of Fig. 5, the delay

network 24 is included in the input circuit of vacuum tube 11, which is in this case the sensitivity-controlling circuit.

The operation of the circuit of Fig. 5 is generally similar to that of Fig. 1 and it is believed that no further description thereof is necessary for a complete understanding of the arrangement.

The circuit of Fig. 6 is generally similar to that of Fig. 3 and similar circuit elements have been given identical reference numerals. The primary difference in the circuits is that in Fig. 6 the delay network 24 is included only in the input circuit of vacuum tube 10, which is the sensitivity-controlling circuit, instead of in the output circuit as in Fig. 3. The operation of the system of Fig. 6 is generally similar to that of Fig. 3 and no further explanation is believed to be necessary.

The primary difference between the embodiments of the invention illustrated in Figs. 1 and 5 and those of Figs. 3 and 6 is in the relation between cutoff amplitudes of the tube and the amplitude of the triggering pulses. Thus, in the case of Fig. 1, the arrangement may be biased considerably below the cutoff point. During the charging period the anode voltage rises so that a relatively small delayed voltage from the delay network is sufficient to bias the tube to an operative condition. In the circuit of Fig. 3, on the other hand, there is no voltage rise corresponding to that of condenser 11 of Fig. 1 and the pulse fed back by the delay network must alone be sufficient to cause the tube 10 to become conductive.

While there have been described what are at present considered to be the preferred embodiments of this invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A periodic wave repeater for producing periodic output pulses comprising, a repeater device having an input circuit and an output circuit, one of said circuits constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said repeater, and means so coupling said terminals of said network to said sensitivity-controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse from said repeater is due.

2. A periodic wave repeater for producing periodic output pulses in response to periodic input pulses comprising, a vacuum tube including an input circuit and an output circuit, one of said circuits constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said repeater, and means so coupling said terminals of said network only to said sensitivity-controlling circuit that said network derives from certain of said periodic input pulses a delayed pulse occurring during a prede-

termined succeeding input pulse and applies said delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse of said repeater is due.

3. A periodic wave generator for producing periodic output pulses in response to input pulses comprising, a vacuum tube having an input circuit and an output circuit, said vacuum tube and circuits comprising means for producing relaxation oscillations, a time constant circuit having a plurality of terminals between which there is effectively a time constant approximately equal to the period of said output pulses, and means so coupling said terminals only to one of said input and output circuits that said time constant circuit derives an input pulse from said one of said circuits at the time an output pulse of said generator is being generated and applies a delayed pulse to said one of said circuits with such polarity as to sensitize said vacuum tube at the time the succeeding output pulse from said generator is due.

4. A periodic wave generator for producing periodic output pulses in response to input pulses comprising, a vacuum tube having an input circuit and an output circuit, said tube being biased considerably beyond cutoff, said vacuum tube and circuits comprising means for producing relaxation oscillations, a time constant circuit having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said generator, and means so coupling said terminals only to one of said input and output circuits that said time constant circuit derives an input pulse from one of said circuits at the time an output pulse of said generator is being generated and applies a delayed pulse to said one of said circuits with such polarity as to condition said tube near its cutoff point at the time the succeeding output pulse from said generator is due.

5. A periodic wave generator for producing periodic output pulses in response to input pulses comprising, a vacuum tube having an input circuit and an output circuit, said vacuum tube and circuits comprising means for producing relaxation oscillations, one of said circuits constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said generator, and means so coupling said terminals of said network only to said sensitivity-controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said generator is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said tube at the time the succeeding output pulse from said generator is due to determine the periodicity of said oscillations.

6. A periodic wave generator for producing periodic output pulses in response to periodic input pulses comprising, a vacuum tube having an input circuit and output circuit, means including a feed-back coupling between said circuits for causing said tube to produce relaxation oscillations, one of said circuits constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said generator, and means so coupling said terminals

of said network only to said sensitivity controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said generator is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said tube at the time the succeeding output pulse from said generator is due to determine the periodicity of said oscillations.

7. A periodic wave repeater for producing periodic output pulses in synchronism with predetermined ones of periodic input pulses comprising, a repeater device having an input circuit and an output circuit, one of said circuits constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to a predetermined multiple of the period of said input pulses of said repeater, and means so coupling said terminals of said network only to said sensitivity-controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse from said repeater is due.

8. A periodic wave repeater for producing periodic output pulses comprising, a repeater device having an input circuit and an output circuit, one of said circuits constituting a sensitivity-controlling circuit, and a delay network included only in said sensitivity-controlling circuit and having a time delay approximately equal to the period of the output pulses of said repeater, said delay network comprising terminals coupled in said sensitivity-controlling circuit and including a reflecting filter having a voltage-reversing reflecting junction remote from said terminals and being terminated at said terminals to prevent reflection thereat, said network being connected to derive an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and to apply a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse of said repeater is due.

9. A periodic wave repeater for producing periodic output pulses comprising, a repeater device having an input circuit and an output circuit, said output circuit constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of the said repeater, and means so coupling said terminals of said network only to said sensitivity-controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse of said repeater is due.

10. A periodic wave repeater for producing periodic output pulses comprising, a repeater device having an input circuit and an output circuit, said input circuit constituting a sensitivity-controlling circuit, a delay network having a plurality of terminals between which there is effectively a time delay approximately equal to the period of the output pulses of said repeater, and

means so coupling said terminals of said network only to said sensitivity-controlling circuit that said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse from said repeater is due.

11. A periodic wave repeater for producing periodic output pulses comprising an input circuit and an output circuit, one of said circuits constituting a sensitivity-controlling circuit, and a delay network included only in said sensitivity-controlling circuit and having a time delay approximately equal to the period of the output pulses of said repeater, said delay network comprising a two-terminal voltage-reversing reflecting filter, an impedance coupled across the terminals of said filter and substantially matching the image impedance thereof to prevent reflection thereat, the terminals of said filter being coupled in said sensitivity-controlling circuit and the impedance across said terminals comprising the major impedance of said sensitivity-controlling circuit, whereby said network derives an input pulse from said sensitivity-controlling circuit at the time an output pulse of said repeater is being generated and applies a delayed pulse to said sensitivity-controlling circuit with such polarity as to sensitize said repeater at the time the succeeding output pulse from said repeater is due.

12. A pulse wave repeater stage for producing output pulses comprising, a repeater device having input and output circuits one of which is adapted to have applied thereto a signal including a pair of pulses with predetermined time separation, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, means for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a predetermined interval, and means including said repeater device responsive jointly to said delayed pulse and said second pulse for deriving an output pulse only during said predetermined interval.

13. A periodic-pulse wave repeater stage for producing periodic output pulses comprising, a repeater device having input and output circuits one of which is adapted to have applied thereto a periodic-pulse wave with predetermined time separation between pulses, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, means for deriving from selected pulses of said periodic-pulse wave periodic pulses delayed for a time less than said predetermined time and having a duration such that they coincide in time with selected pulses of said signal for a predetermined interval, and means including said repeater device responsive jointly to said delayed pulses and said selected pulses for deriving output pulses only during said predetermined intervals.

14. A pulse wave repeater stage for producing output pulses comprising, a repeater device having input and output circuits one of which is adapted to have applied thereto a signal including a pair of pulses with predetermined time separation, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, a

reflecting polarity-reversing delay filter coupled to one of said circuits for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a predetermined interval, and means including said repeater device responsive jointly to said delayed pulse and said second pulse for deriving an output pulse only during said predetermined interval.

15. A pulse wave repeater stage for producing output pulses comprising, an input circuit adapted to have applied thereto a pair of pulses with predetermined time separation and including means for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a predetermined interval and means for combining said second and delayed pulses to develop a pulse greater in amplitude than either, pulse-responsive means coupled to said input circuit and responsive to said combined pulses, and means included in said input circuit for maintaining said last-named means normally insensitive to any of said pulses alone.

16. A pulse wave repeater stage for producing output pulses comprising, a repeater device having input and output circuits one of which is adapted to have applied thereto a signal including a pair of pulses with predetermined time separation, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, means coupled to said one of said circuits for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a

predetermined interval, and means including said repeater device responsive jointly to said delayed pulse and said second pulse for deriving an output pulse only during said predetermined interval.

17. A pulse wave repeater stage for producing output pulses comprising, a repeater device having an output circuit and an input circuit adapted to have applied thereto a signal including a pair of pulses with predetermined time separation, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, means coupled to said output circuit for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a predetermined interval, and means including said repeater device responsive jointly to said delayed pulse and said second pulse for deriving an output pulse only during said predetermined interval.

18. A pulse wave repeater stage for producing output pulses comprising, a repeater device having an output circuit and an input circuit adapted to have applied thereto a signal including a pair of pulses with predetermined time separation, means comprised in said repeater device and its associated circuits for maintaining the stage normally insensitive to said pulses alone, means coupled to said input circuit for deriving from the first pulse of said pair a pulse delayed for a time less than said predetermined time and having a duration such that it coincides in time with the second pulse of said pair for a predetermined interval, and means including said repeater device responsive jointly to said delayed pulse and said second pulse for deriving an output pulse only during said predetermined interval.

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