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PERIODIC WAVE REPEATER

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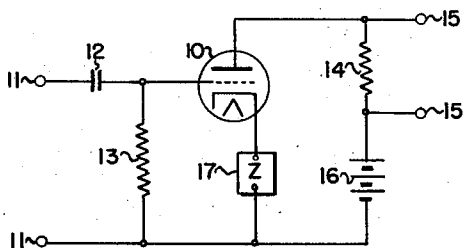


FIG. 1.

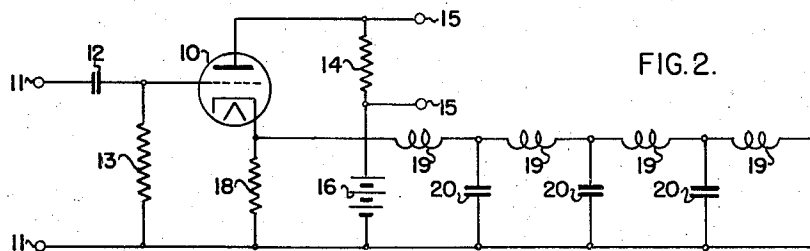


FIG. 2.

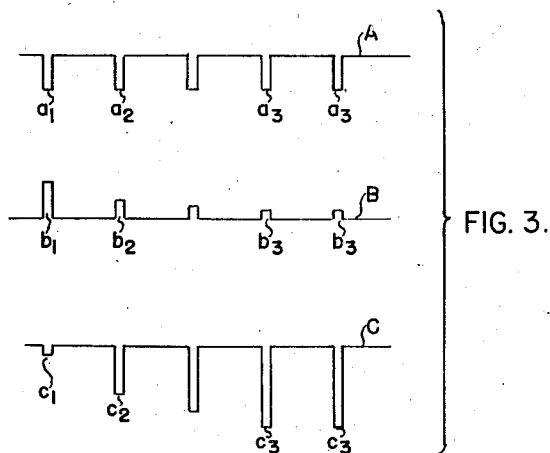


FIG. 3.

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PERIODIC WAVE REPEATER

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12 Claims. (Cl. 250—27)

This invention relates to periodic wave repeaters and, while the invention is of general application, the periodic wave repeater of the invention is particularly suitable for effectively repeating only predetermined pulses of a periodic-pulse wave for use in a television signal receiver.

It is frequently desirable, especially in the synchronizing system of a television signal receiver, to clean all undesired or spurious pulses, noise, and static from a periodic-pulse wave and to repeat only selected desired pulses. In the past it has been proposed to use selectively-responsive periodic wave repeaters for this purpose. For example, it has been proposed to provide a periodic wave repeater comprising a vacuum tube normally biased substantially to cutoff and having input and output circuits one of which is a sensitivity-controlling circuit for the vacuum tube. A time-delay network is coupled to the sensitivity-controlling circuit and, at the time a given output pulse is due from the repeater, there is applied to the delay network an input pulse which is so delayed by the network and applied to the sensitivity-controlling circuit thereby with such polarity as to sensitize the vacuum tube for operation at the time the succeeding output pulse is due. Certain of such periodic wave repeaters, while effective to an extent in cleaning interference and unwanted pulses from selected pulses of a periodic-pulse wave, for example, a synchronizing-pulse wave, are not entirely effective in cleaning all unwanted frequency components from the wave so that, for example, a clean line-synchronizing wave may be applied to the line-scanning oscillator. Certain other of such periodic repeaters are regenerative, so that the circuit design is critical and the output of the generator varies in amplitude with the amplitude of the input periodic-pulse wave.

It is an object of the present invention, therefore, to provide an improved periodic wave repeater which is effective to overcome one or more of the above-mentioned disadvantages and undesirable features of the arrangements of the prior art.

It is another object of the invention to provide an improved periodic wave repeater which is effective to repeat nonregeneratively-selected pulses of a periodic-pulse wave and selectively to degenerate all other signal components.

It is a specific object of the invention to provide a periodic wave repeater which is effective to clean the synchronizing-pulse wave of a tele-

vision signal receiver of all unwanted frequency components.

In accordance with the present invention, there is provided a periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses, which comprises a vacuum tube having an input circuit adapted to have said wave applied thereto, and an output circuit. The repeater includes also impedance means degeneratively coupling these circuits and effective to apply to the input circuit a voltage of the same phase as that of the output circuit and including frequency-selective means for substantially reducing the degenerative effect thereof at the fundamental frequency and at least one harmonic frequency of the aforesaid predetermined pulses. The impedance means may comprise frequency-selective means tuned to resonate at the fundamental frequency and one or more harmonic frequencies of the predetermined pulses for reducing the degenerative effect of the impedance means at such frequencies, thereby to clean the wave of unwanted frequency components. The impedance means alternatively may include a reflecting time-delay circuit for altering the degenerative effect of the impedance means to predetermined pulses.

For a better understanding of the present 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 accompanying drawing, Fig. 1 is a circuit diagram, partially schematic, of a periodic wave repeater embodying the present invention; Fig. 2 is a circuit diagram of a modification of the circuit of Fig. 1; while Fig. 3 is a group of curves of assistance in explaining the operation of the invention.

Referring now more particularly to Fig. 1 of the drawing, there is illustrated a periodic wave repeater comprising a vacuum tube 10 having an input circuit the terminals 11, 11 of which are adapted to have applied thereto a wave including periodic pulses, such as the synchronizing-signal wave of a television signal receiver. Included in the input circuit are a coupling condenser 12 and a grid-leak resistor 13. The output circuit of the tube 10 includes a coupling resistor 14 across which are connected output terminals 15, 15, and a source of unidirectional potential 16. The input and output circuits of tube 10 have a single path common thereto, comprising a cathode circuit, and are degeneratively coupled by fre-

quency-selective impedance means 17 connected in the portion of the cathode circuit common to the input and output circuits and including frequency-selective means resonant at the fundamental frequency and at least one harmonic frequency of the applied periodic pulses for developing a degenerative effect which is greater at frequencies other than the fundamental frequency and at least one harmonic frequency of the pulses desired to be repeated by the tube 10. For example, the impedance means 17 may comprise conventional circuit means tuned to provide minimum terminal impedance only at the fundamental frequency and one or more harmonic frequencies of the predetermined pulses. At all other frequencies the impedance of the unit 17 is made large relative to that of the coupling resistor 14. A conventional circuit fulfilling the requirements of an impedance means of this character is shown in "Electric Circuits and Wave Filters" by A. T. Starr (Pitman—1934) page 216, Fig. 198.

In considering the operation of the periodic wave repeater shown in Fig. 1, it will be assumed that an input wave including periodic pulses is applied to the input terminals 11, 11. The impedance means 17 is effective to apply to the input circuit of tube 10 a voltage of the same phase as that of the output circuit of this tube for substantially reducing the degenerative effect of the impedance means 17 at the fundamental frequency and at least one harmonic frequency of the applied periodic pulses. Thus, those frequency components of predetermined pulses at which the impedance 17 has a minimum impedance, and hence is not substantially degenerative, are repeated by the tube 10 in a normal way and appear at the output terminals 15, 15. However, at all other frequencies, the impedance of the unit 17 is the controlling impedance in the output circuit of tube 10 so that signal components at such frequencies are materially decreased in amplitude and the wave form which they represent is diminished in magnitude across the coupling resistor 14 or output terminals 15, 15. That is, the unwanted pulses are effectively reduced by the degenerative effect of the impedance means 17.

Referring now more particularly to Fig. 2, the periodic wave repeater shown is essentially similar to that of Fig. 1 and similar circuit elements have been given identical reference numerals. The circuit of Fig. 2 differs primarily from that of Fig. 1 in that the cathode circuit of vacuum tube 10, which is common to the input and output circuits, includes a frequency-selective degenerative means consisting of a resistor 18 and a reflecting time-delay circuit connected thereacross comprising series-inductance elements 19 and shunt-capacitance elements 20 and terminating at its remote end in a short-circuit. The delay circuit may include any desired number of elements 19, 20 depending upon the desired degree of fidelity of reproduction of repeated pulses. The delay circuit and resistor 18 together have minimum terminal impedance at the fundamental frequency and at least one harmonic frequency of the periodic pulses as described more fully in the copending United States patent application of Harold M. Lewis, Serial No. 262,846, filed March 20, 1939.

In considering the operation of the periodic wave repeater of Fig. 2, reference is made to Fig. 3 illustrating a wave A, including predetermined periodic pulses, which is applied to the input cir-

cuit of tube 10. The first input pulse a_1 results in the formation of a large first degenerative pulse b_1 of wave B across cathode resistor 18 which has a large degenerative effect on the first repeated output pulse c_1 of output wave C. The next input pulse a_2 , however, occurs at the same instant as the delayed and reversed reflection of the first pulse applied to the delay circuit 19, 20 appears across resistor 18. These two pulses of opposite polarity partially cancel each other so that the net degenerative pulse b_2 is reduced and the degenerative effect of resistor 18 is partially neutralized as to such input pulse a_2 and the second output pulse c_2 is consequently of increased amplitude. If there is a mismatch of the impedance of resistor 18 and that of the circuit including elements 19, 20, multiple reflections are set up which aids the desired degenerative action and, as this action continues, the amplitude of the output pulses of wave C increases to a maximum represented by the pulse c_3 which has a steady value determined largely by the amount of mismatching of the impedance of resistor 18 with the reflecting filter 19, 20. Likewise, the resultant degenerative pulses b_3 reach a small constant amplitude determined primarily by the mismatching of the system. The rate at which the output pulses build up and also their final amplitudes are thus determined primarily by the degree of impedance mismatch between the resistor 18 and the delay circuit 19, 20.

If there is no mismatch of impedances as between element 18 and the time-delay reflecting filter including elements 19, 20, there are, of course, no reflections of the delayed pulses at resistor 18 and the output amplitude of the wanted pulses reach their maximum value upon the simultaneous application of the second pulse a_2 of curve A and the reflected pulse b_2 to the system.

While the input circuit of the tube 10 may be subject to the application of static, interference, and spurious pulses along with the input wave A, the frequency components thereof are such that as to them the resistor 18 is degenerative in the normal manner, the time delay of the reflecting circuit 19, 20 being such that their reflections, due to their sporadic occurrence, are not, in general, in phase with any subsequent spurious or unwanted pulses and, since the reflected pulses are of opposite polarity, they are effective to develop only output pulses of opposite polarity which can be readily suppressed.

It is seen, therefore, that the system of the invention is effective to amplify the pulses of curve A to provide very much increased amplitude of corresponding pulses in the output of the system. Therefore, amplitude-selecting means coupled at a point in the system succeeding terminals 15 may be utilized completely to separate the wanted pulses from the spurious or unwanted pulses which appear with very much reduced relative amplitude in the output of the system. Such amplitude-selecting means may be such as to select only a predetermined portion of the amplitude range of the output signal in a manner well understood in the art. Also, it will be understood that the signal input to the system of the invention can be limited so that no unwanted components appear in the input to tube 10 with amplitudes appreciably greater than the amplitude of the wanted pulses applied to the input circuit of tube 10.

While there have been described what are at present considered to be the preferred embodi-

ments 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 adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and impedance means degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including frequency-selective means for substantially reducing the degenerative effect thereof at the fundamental frequency and at least one harmonic frequency of said predetermined pulses.

2. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and impedance means degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including frequency-selective means resonant at the fundamental frequency and at least one harmonic frequency of said predetermined pulses of said wave for substantially reducing the degenerative effect of said impedance means to said pulses.

3. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and impedance means degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including a time-delay circuit for substantially reducing the degenerative effect of said impedance means to said predetermined pulses of said wave, whereby said vacuum tube is effective to repeat such pulses.

4. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and an impedance element degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including a reflecting time-delay circuit coupled to said impedance element for reducing the degenerative effect of said impedance element to said predetermined pulses of said wave, whereby said vacuum tube is effective to repeat such pulses.

5. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and impedance means degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including a time-delay circuit terminated at its remote end in a short-circuit for decreasing the degenerative effect of said impedance means to said predetermined pulses of

said wave, whereby said vacuum tube is effective to repeat such pulses.

6. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and impedance means degeneratively coupling said circuits and effective to apply to said input circuit a voltage of the same phase as that of said output circuit and including a time-delay circuit for substantially neutralizing the degenerative effect of said impedance means to said predetermined pulses of said wave, whereby said vacuum tube is effective to repeat such pulses.

7. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, a resistor degeneratively coupling said circuits to render said vacuum tube normally unresponsive to repeat said wave, and a time-delay circuit coupled to said resistor for reducing the degenerative effect of said resistor to said predetermined pulses of said periodic-pulse wave, whereby said vacuum tube is effective to repeat such pulses.

8. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, a cathode circuit common to said circuits and including impedance means effective to apply to said input circuit a voltage of the same phase as that of said output circuit, and frequency-selective means included in said impedance means for substantially reducing the degenerative effect thereof at the fundamental and at least one harmonic frequency of said predetermined pulses.

9. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, a cathode circuit common to said circuits and including an impedance element to render said vacuum tube normally unresponsive to repeat said wave, and a reflecting time-delay circuit coupled to said impedance element and terminated at its remote end in a short-circuit for neutralizing at least a portion of the degenerative effect of said impedance element to said predetermined pulses of said wave, whereby said vacuum tube is effective to repeat such pulses.

10. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, a cathode circuit common to said circuits and including a resistor to render said vacuum tube normally unresponsive to repeat said wave, and a reflecting time-delay circuit connected across said resistor and terminated at its remote end in a short-circuit for substantially neutralizing the degenerative effect of said resistance means to said predetermined pulses of said wave, whereby said vacuum tube is effective to repeat such pulses.

11. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum tube having an input circuit adapted to have said wave applied thereto and an output circuit, and

impedance means connected degeneratively to couple said circuits, said impedance means including frequency-selective means having minimum terminal impedance at the fundamental frequency and at least one harmonic frequency of said predetermined pulses, whereby such pulses are repeated by said vacuum tube.

12. A periodic wave repeater adapted effectively to repeat only predetermined pulses of a wave including periodic pulses comprising, a vacuum

5 tube having an input circuit adapted to have said wave applied thereto and an output circuit, a single path common to said circuits, and impedance means included in said path and including frequency-selective means connected degeneratively to couple said circuits for modifying the degenerative effect thereof at the fundamental frequency and at least one harmonic frequency of said predetermined pulses.

10 JOHN C. WILSON.