Oct. 15, 1940. H. M. LEWIS 2,217,957

WAVE-SIGNAL TRANSLATING SYSTEM

Filed May 26, 1939

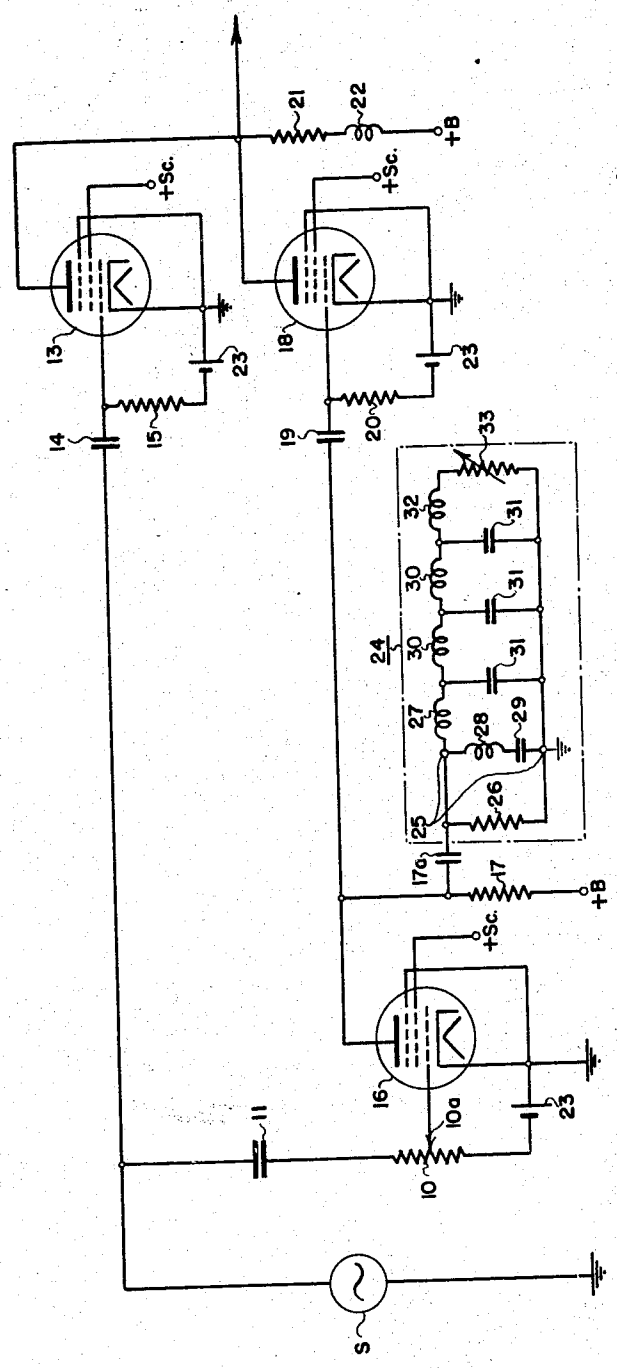


FIG. 1.

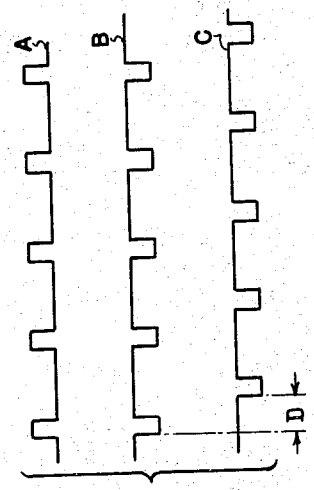


FIG. 2.

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Patented Oct. 15, 1940

2,217,957

UNITED STATES PATENT OFFICE

2,217,957

WAVE-SIGNAL TRANSLATING SYSTEM

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Application May 26, 1939, Serial No. 275,781

10 Claims. (Cl. 178—44)

This invention relates to wave-signal translating systems. The invention is especially concerned with signal-translating systems of the type adapted to effect predetermined time delay in the translation of signals.

Various systems have heretofore been devised for the purpose of effecting time delays in the translation of wave signals. Ordinarily, these systems have comprised networks or transmission lines having input terminals to which the signals are applied and output terminals at their remote ends at which the delayed signals appear. In order to obtain time delays of appreciable magnitude, it has been necessary to provide relatively long transmission lines, either actual or artificial, embodying a large amount of relatively expensive physical apparatus, the amount of apparatus required being substantially directly proportional to the amount of time delay required.

It is an object of the present invention, therefore, to provide an improved wave-signal translating system adapted to provide a predetermined time delay in the translation of a wave signal and embodying a relatively small amount of physical apparatus.

It is a further object of the invention to provide a system of the type described, characterized by simplicity of construction, efficiency in operation, and adjustability for effecting various controls of the translated signal.

In accordance with the present invention, there is provided a wave-signal translating system comprising an input circuit to which is coupled a reflecting delay network, preferably a dead-end filter network, adapted to reflect the signal with a predetermined time delay. An output circuit is coupled to the input circuit for translating the delayed signal and the input and output circuits are also coupled by additional means for neutralizing or substantially suppressing the undelayed signal. The latter means preferably comprise means for reversing the polarity of the undelayed signal and for combining it in the output circuit with the undelayed signal of opposite polarity. In a preferred embodiment of the invention, the remote end of the delay network is terminated in an adjustable impedance and means are provided for adjusting this impedance, thereby to adjust the polarity and amplitude of the reflected wave.

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 accompanying drawing, Fig. 1 is a circuit diagram of an electric signal-translating system embodying the present invention; while Fig. 2 is a group of curves illustrating the wave forms of waves appearing at various points in the system of Fig. 1 to aid in the understanding of the invention.

Referring now more particularly to Fig. 1 of the drawing, there is illustrated a wave-signal translating system embodying the present invention and comprising an input circuit including a resistor 10 connected by way of a coupling condenser 11 across a wave-signal source indicated at S. Connected to the input circuit 10, 11 is a first signal-translating channel comprising a vacuum tube 13 having its input electrodes coupled to the input circuit 10, 11 by way of a suitable coupling condenser 14 and leak resistor 15. A second signal-translating channel is also coupled to the input circuit and preferably comprises a polarity-reversing vacuum tube 16 having its control grid connected to a suitable tap 10a on the resistor 10 and having a load resistor 17 in its anode circuit. A second vacuum tube 18 is included in the second signal-translating channel with its input electrodes connected across load resistor 17 by way of suitable coupling condenser 19 and leak resistor 20. The tubes 13 and 18 are connected in parallel to a common output circuit including a series resistor 21 and inductance 22. Preferably the tubes 13, 16, and 18 are all of the conventional pentode type having suitable potentials applied to their screens from sources indicated at +Sc. In each of the control grid-cathode circuits of these tubes a suitable bias source, such as a battery 23, is included. Operating potentials are applied to the anodes of the tubes 13 and 18 from a suitable source indicated at +B by way of the load resistor 21 and inductance 22 and to the tube 16 by way of the load resistor 17.

For the purpose of effecting a predetermined delay in the translation of the wave signal applied to the input circuit 10, 11 of the system, there is provided a reflecting delay network indicated generally at 24. The network 24 comprises a low-pass filter of the dead-end type, including input terminals 25 which are connected across the load resistor 17 by way of a suitable coupling condenser 17a, and an input terminating resistor 26. The filter 24 as coupled to the input terminals 25 comprises an m-derived half-section, consisting of a shunt arm comprising a series-connected inductance 28 and condenser 29 and a se-

ries arm comprising an inductance 27, coupled to a series of constant-k whole-sections individually comprising full-series inductance arms 30 and full-shunt condenser arms 31 and terminated in a mid-series inductance arm 32. Across the remote terminals of the filter there is connected an adjustable terminating impedance, for example, a resistor 33, the value of which may be varied over a wide range of values.

The operation of the system of the present invention may best be explained with reference to the curves of Fig. 2. While the system is adapted for translation of a signal of any wave form or frequency, for the purpose of clarity, the translation of a periodic rectangular-pulse signal is assumed by way of example. Curve A of Fig. 2 illustrates the appearance of such a wave as it may be supplied from the source S and impressed upon the input circuit 10, 11 of the system. This wave is translated by the first channel of the system by way of the tube 13 with a reversal in its polarity so that its wave form, as repeated by this tube, is as illustrated by curve B. The wave is further translated by the second channel of the system by way of the tubes 16 and 18, each of which effects a reversal in the polarity thereof, so that the signal-input wave as repeated by tube 18 has its original polarity, as illustrated by curve A, opposite to that which it has as repeated by the tube 13. By properly proportioning the gain of the tubes 13, 16, and 18, and adjusting the signal input to tube 16 by tap 10a, these two waves may be made identical in amplitude but opposite in polarity and, being combined in the additive common output circuit, they neutralize or cancel one another. The undelayed wave is thus substantially suppressed and does not appear across the output load circuit 21, 22.

The signal repeated by the tube 16 is also impressed upon the input terminals 25 of the delay network 24 by way of the load resistor 17 and condenser 17a. The delay network 24 comprises a two-terminal filter network and, with the value of the terminating resistor 33 properly adjusted, for example, to an extremely high value so that its remote terminals are open-circuited, the wave impressed on its input circuit is translated to the remote terminals and then reflected back, with its original polarity, to the input terminals 25 where it appears as illustrated by curve C of Fig. 2. The reversal in polarity of wave C with respect to the wave A is due to the tube 16, the time delay indicated at D being effected by the network 24. The time delay in the passage of the signal from its input terminals 25 to its remote end need be but one-half of the desired time delay, since the signal is also delayed in its reflected passage back to the input terminals. Hence, only one-half of the physical apparatus which would ordinarily be required to obtain the desired delay is utilized by the system of the present invention. The resistor 26 terminates the filter in its image impedance, so that there is no further reflection of the echo or reflected wave. The reflected wave of the network 24 is impressed upon the input electrodes of the tube 18 and is repeated in the output circuit of this tube and a voltage representing the delayed signal appears across the load circuit elements 21, 22 free from the undelayed signal which is suppressed in this load circuit as described above.

By adjustment of the terminating resistor 33 so that its value is approximately zero, the filter is effectively short-circuited at its remote end and, under this condition, the reflected wave is of opposite polarity to that of the wave impressed on its input terminals. At an intermediate value of the resistor 33 corresponding to the image impedance of the filter, there is no reflection from the remote end, that is to say, the amplitude of the reflected wave is then zero. Adjustment of the resistor 33 thus affords a convenient control of both the amplitude and polarity of the reflected delayed wave which is translated by the system.

While there has been described what is at present considered to be the preferred embodiment 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 wave-signal translating system comprising an input circuit adapted to have a wave signal impressed thereon, a reflecting delay network coupled to said input circuit, an output circuit coupled to said network for translating said delayed signal, and additional means coupling said input and output circuits for neutralizing the undelayed signal in said output circuit.

2. A wave-signal translating system comprising an input circuit adapted to have a wave signal impressed thereon, a reflecting delay network having input terminals coupled to said input circuit, an output circuit coupled to said terminals for translating said delayed signal, and additional means coupling said input and output circuits for neutralizing the undelayed signal in said output circuit.

3. A wave-signal translating system comprising an input circuit adapted to have a wave signal impressed thereon, a reflecting delay network having input terminals coupled to said input circuit, an output circuit coupled to said terminals for translating the delayed signal and incidentally translating the undelayed signal, and additional means coupling said input and output circuits for translating said undelayed signal therebetween with a polarity opposite to said incidentally translated undelayed signal, whereby said undelayed signal is substantially suppressed in said output circuit.

4. A wave-signal translating system comprising an input circuit adapted to have a wave impressed thereon, an output circuit, a first signal-translating channel coupling said input and output circuits for translating said signal to said output circuit with one polarity, a second signal-translating channel coupling said input and output circuits for translating said signal to said output circuit with equal amplitude and opposite polarity, whereby the undelayed signal is substantially suppressed in said output circuit, and a reflecting delay network having input terminals coupled to one of said channels and adapted to reflect said signal with a predetermined time delay.

5. A wave-signal translating system comprising an input circuit adapted to have a wave impressed thereon, an output circuit, a first signal-translating channel coupling said input and output circuits and including an odd number of vacuum-tube repeaters for translating said signal to said output circuit with one polarity, a second signal-translating channel coupling said input and output circuits and including an even num-

ber of vacuum-tube repeaters for translating said signal to said output circuit with equal amplitude and opposite polarity, whereby the undelayed signal is substantially suppressed in said output circuit, and a reflecting delay network having input terminals coupled to one of said channels and adapted to reflect said signal with a predetermined time delay.

6. A wave-signal translating system comprising an input circuit adapted to have a wave signal impressed thereon, a reflecting delay network having input terminals coupled to said input circuit, an output circuit coupled to said terminals for translating said delayed signal, additional means coupling said input and output circuits for neutralizing the undelayed signal in said output circuit, and means for adjusting said network to control the amplitude of the delayed translated signal.

7. A wave-signal translating system comprising an input circuit adapted to have a wave signal impressed thereon, a reflecting delay network having input terminals coupled to said input circuit, an output circuit coupled to said terminals for translating said delayed signal, additional means coupling said input and output circuits for neutralizing the undelayed signal in said output circuit, and means for adjusting said network to control the amplitude and polarity of the delayed translated signal.

8. A wave-signal translating system comprising an input circuit adapted to have a wave impressed thereon, a dead-end filter network having input terminals coupled to said input circuit and adapted to reflect said signal with a predetermined time delay, an output circuit coupled to said terminals for translating the delayed signal, and means connected between said input and output circuits for neutralizing the undelayed signal in said output circuit.

9. A wave-signal translating system comprising an input circuit adapted to have a wave impressed thereon, a dead-end filter network having its input terminals coupled to said input circuit and adapted to reflect said signal with a predetermined time delay, said network including an adjustable terminating impedance at its remote end, an output circuit coupled to said network for translating the delayed signal, means connected between said input and output circuits for neutralizing the undelayed signal in said output circuit, whereby adjustment of said impedance is effective to vary the amplitude and polarity of the translated delayed signal.

10. A wave-signal translating system comprising an input circuit adapted to have a wave impressed thereon, an output circuit, a first signal-translating channel coupling said input and output circuits for translating said signal to said output circuit with one polarity, a second signal-translating channel for translating said signal to said output circuit with an opposite polarity, whereby the undelayed signal is substantially suppressed in said output circuit, and a dead-end filter network including an adjustable terminating impedance at its remote end and having input terminals coupled to one of said channels for reflecting said signal with a predetermined time delay, whereby adjustment of said impedance is effective to vary the amplitude and polarity of the translated delayed signal.

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