

Sept. 13, 1949.

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TRANSFORMER RESPONDING TO VARIATIONS
IN AMPLITUDE OF INPUT WAVES
Filed July 10, 1947

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FIG. 1

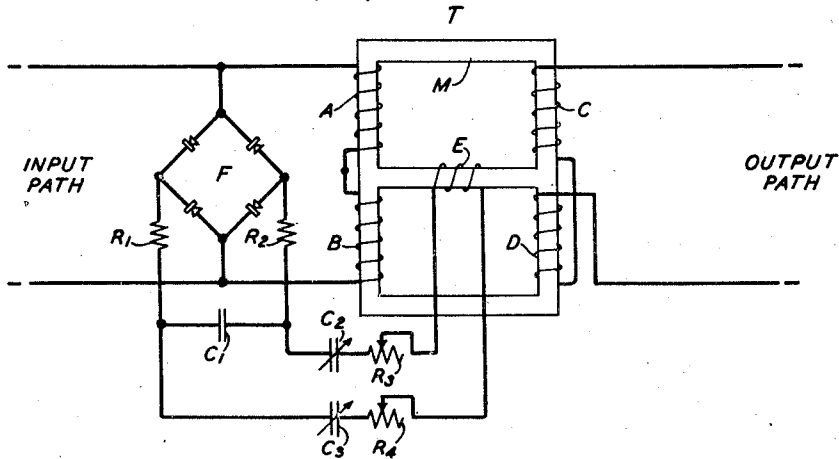


FIG. 2

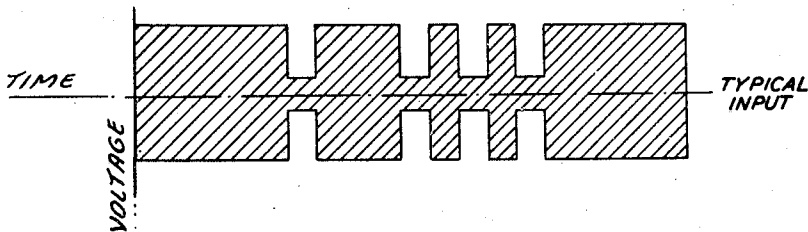
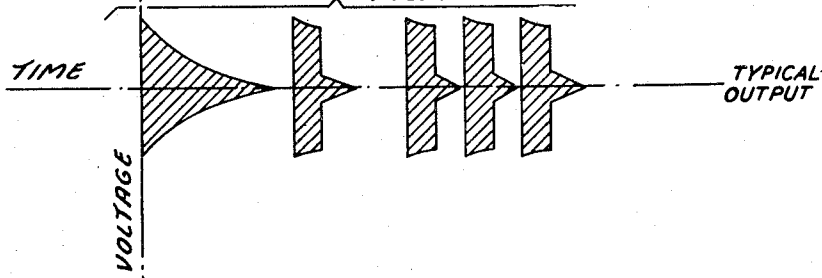


FIG. 3



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TRANSFORMER RESPONDING TO VARIATIONS IN AMPLITUDE OF INPUT WAVES

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Application July 10, 1947, Serial No. 759,986

6 Claims. (Cl. 323-48)

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This application pertains to a transformer circuit and more particularly to a transformer circuit which impresses a voltage change on its output circuit only in response to the change in the amplitude of the envelope of an alternating voltage wave impressed on its input circuit. The transformer circuit of the present invention is an envelope differentiator transformer circuit.

There are presently known and available in the art circuits which respond to variations in the amplitude of the envelope of a voltage wave by generating voltage waves indicative of the change. The circuit of the present invention, however, has the advantage that it is much less expensive than the known circuits.

This circuit may be used, for instance, in communication to identify dial pulses. Such pulses may be generated in dialing, for instance, by changing the impedance of a line to which an alternating current voltage, or tone, of constant amplitude is applied. The variation in the impedance introduced by the dialing will change the amplitude of the tone voltage wave impressed on the input of the transformer circuit, in accordance with the pattern of the dial impulses. The change in the amplitude of the wave envelope, corresponding to the signal train of the dial pulses, impressed on the input circuit will generate a train of voltage waves in the transformer output circuit indicative of the dialed impulses. The transformer circuit of the invention has other applications and may be applied wherever it is desired to transform a variation in the amplitude of the envelope of a voltage wave into a signal. Such signal may be of differing patterns and of differing durations dependent upon the constants of the cooperating apparatus elements in the circuit.

An object of this invention is the transformation of changes in amplitude only of the envelope of a voltage wave in the input of a transformer circuit into voltage waves in the transformer output circuit.

Another object of the invention is the control of the duration of the signal generated in the output circuit in response to the changes in the amplitude of the envelope of the input signal.

A further object of the invention is to provide a less expensive circuit for indicating changes in amplitude of the envelope of voltage waves than those presently known in the art.

The invention may be understood from the following description when read with reference to the associated drawing showing a preferred embodiment in which the invention is presently in-

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corporated. It is to be understood, however, that the invention may be incorporated in other embodiments which will be comprehended by those skilled in the art from the disclosure herein. In the drawings, Fig. 1 shows the transformer circuit of the invention; Fig. 2 shows a typical input wave; and Fig. 3 shows a typical output wave.

Refer to Fig. 1 which shows the envelope differentiator transformer circuit. The circuit consists of a pair of wires comprising an input path connecting to the matched windings A and B of transformer T. Windings A and B are connected in series aiding. These windings are mounted preferably upon an easily saturable magnetic core M, but the invention may be practiced with any magnetic core. Also mounted upon this core, and thus electromagnetically coupled to windings A and B, are matched windings C and D. Windings C and D are connected together in series opposing. These are connected to a pair of wires comprising the output path of the device.

Rectifier F is bridged across the input path to transformer T. The output of this rectifier connects to a balanced circuit consisting of series resistors R1 and R2, a parallel condenser C1, series condensers C2 and C3, series resistors R3 and R4, and winding E of transformer T. Winding E is mounted on transformer core M upon a magnetic "bridging" link as indicated. Though none is indicated on the drawing, an amplifier may be included in the circuits associated with the rectifier if this is desirable for providing either electrical amplification or impedance matching.

Operation of the device is as follows:

If an alternating current signal is applied to the input side of the device, essentially no signal will, at first, be transmitted to the output side, due to the fact that the windings A, B, C and D are so electrically and magnetically interconnected that voltages induced in the output circuit are effectively cancelled. This is true even though the intensity of the input signal is great enough to saturate the magnetic core on current peaks. However, immediately after the input signal is applied, a portion of the input current is rectified by rectifier F and the resultant pulsating direct current is sent into condenser C1 via series resistors R1 and R2. The combination R1, R2 and C1 acts as a filter to essentially smooth out the pulsations. The resultant direct current flows to charge condensers C2 and C3 in series with winding E. The charging current to C2 and to C3, flowing in transformer winding E, creates a magnetizing force which unbalances the core of transformer T with respect to windings A, B, C

and D. The magnetic loop linking A and C now saturates at a different point in the incoming alternating current signal cycle than does that linking windings B and D. As a result, there is a short period, occurring twice in each half-wave of the input signal, during which voltages induced in windings C and D are no longer equal. Hence, these voltages do not completely cancel out. As a result, whenever there is charging current in winding E, and an input signal is present, there is an output signal.

If the envelope of the alternating current signal is constant, the voltage output of rectifier F is constant. Accordingly, after a time determined by the constants of the system, condensers C1, C2 and C3 become essentially fully charged and current no longer flows in winding E. Thus, the magnetic unbalance disappears. The transformer is again balanced and no output signal is obtained. Now, if the input signal is changed in amplitude, the voltage out of rectifier F suffers a corresponding change. Accordingly, condensers C1, C2 and C3 start to vary their charge in accordance with this changed voltage, current flows in winding E, the transformer becomes unbalanced, and an output signal is obtained. Eventually, the charge on these condensers would reach a new steady state condition and the output signal would disappear. However, if the change in intensity of the input signal persists for a short time as compared to the charging and discharging time of the circuit associated with winding E, an output signal will be obtained for the duration of the signal intensity change. Following resumption of the normal signal level, there is a short interval during which winding E's circuit returns to the original steady state condition. During this time, there will be a signal in the output of the transformer T until the original charge is again restored to C1, C2 and C3. The phase of the latter signal is 180 degrees removed from the phase of the signal obtained during the short interval of envelope change.

It should be apparent that the duration of the signals in the output may be varied by a proper choice of constants of the charging circuit of winding E. Condensers C3, C4 and resistances R3 and R4 may be variable as indicated to vary the duration of the output signals.

Instead of a single core having a bridging path it is obvious that the invention may be practised with cores of other conformations, such as by means of two individual square or rectangular cores each having individual central openings and abutting along an edge or by means of two separable circular or elliptical rings or tori for instance abutting along their outer boundaries.

The input and output signals are indicated in Figs. 2 and 3, respectively.

Fig. 2 shows the voltage wave envelope of a train of signals such as might be applied to the input of Fig. 1 by the operation of a dial circuit which increased the impedance for each dial pulse as seen by an applied tone.

Fig. 3 shows the resultant output signals. The lengthened first element of the output train in Fig. 3 results from the lengthened interval of current flow in the charging circuit of winding E when voltage is first applied.

The input is presumed to decrease momentarily to provide an output signal. However, it is apparent that the device will operate as well on momentary increases of signal, provided the circuit constants governing the charge and discharge of C1, C2 and C3 are suitable.

We have, thus, a circuit which responds essentially to changes in the intensity of an applied tone. That is to say, it is a "differentiator circuit" which acts upon the envelope of the input signal.

What is claimed is:

1. A voltage wave envelope differentiator circuit comprising a plurality of windings on a magnetic core and instrumentalities for producing a magnetic bias in said core in response to variations in the amplitude of the envelope of a voltage wave, said instrumentalities comprising a winding on said core and a condenser in series with said winding.

2. A transformer, an input and an output circuit connected thereto, said circuits having windings so connected that when the envelope of an alternating voltage wave impressed on said input circuit remains substantially constant in amplitude, there is substantially no voltage impressed on said output circuit, and magnetic means in said transformer actuable solely in response to variations in the envelope of said voltage wave impressed on said input circuit to produce a voltage in said output circuit.

3. A transformer circuit comprising an easily saturable magnetic core, a first winding on said core, a condenser charging circuit connected to said winding, input and output windings on said core, magnetic paths in said core saturable at different points on a voltage wave impressed on said input windings as a result of an unbalance in said paths produced by said first winding in response to changes in the amplitude of an incoming voltage wave, said output windings disposed so as to generate an output wave in response to said unbalance.

4. A voltage wave envelope differentiator circuit, said circuit comprising a magnetic core, said core easily saturable, said core having two magnetic paths, a first pair of input windings connected in series aiding on said core, one of said first pair in each of said paths, a second pair of output windings connected in series opposition on said core, one of said second pair in each of said paths, said windings disposed in relation to said paths so that there is no output from said circuit when a continuous voltage wave applied to said input is of constant amplitude, a control circuit comprising a rectifier, a condenser charging circuit and another winding all interconnected between said input circuit and said core, said other winding wound on a bridging path on said core common to said two paths, said control circuit responsive to a change in amplitude of said wave to unbalance said paths with respect to said input and output windings and impress a voltage wave on said output in response to a change in amplitude of said input wave.

5. A circuit in accordance with claim 4 including means for varying the duration of the output signals.

6. A voltage wave envelope differentiator circuit comprising two magnetic cores having a common magnetic link, a biasing winding encircling a portion of said link, an individual input winding on each of said cores, an individual output winding on each of said cores, said windings so arranged that there is substantially no voltage impressed across a circuit connected to said output windings when an alternating voltage wave of substantially constant amplitude is impressed across an input circuit connected to said input windings, means responsive to a variation in the amplitude of an input voltage wave

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impressed on said input windings for biasing said cores through said biasing winding, and means responsive to said biasing for producing an output voltage wave in said output windings indicative of said variation.

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