

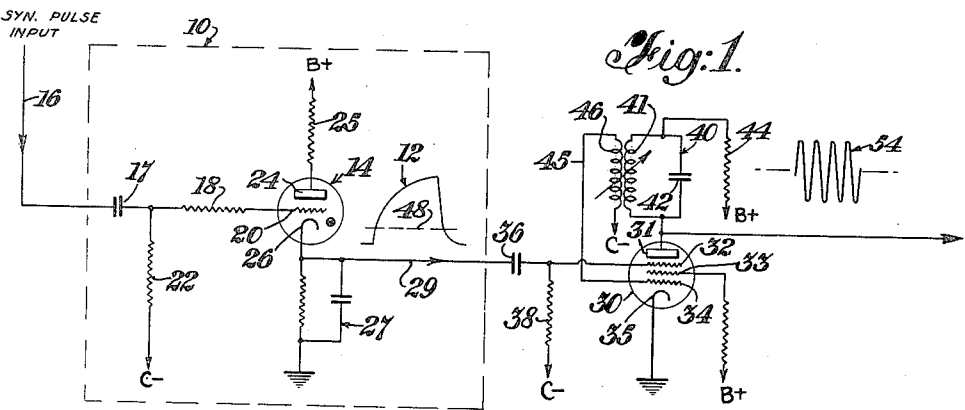
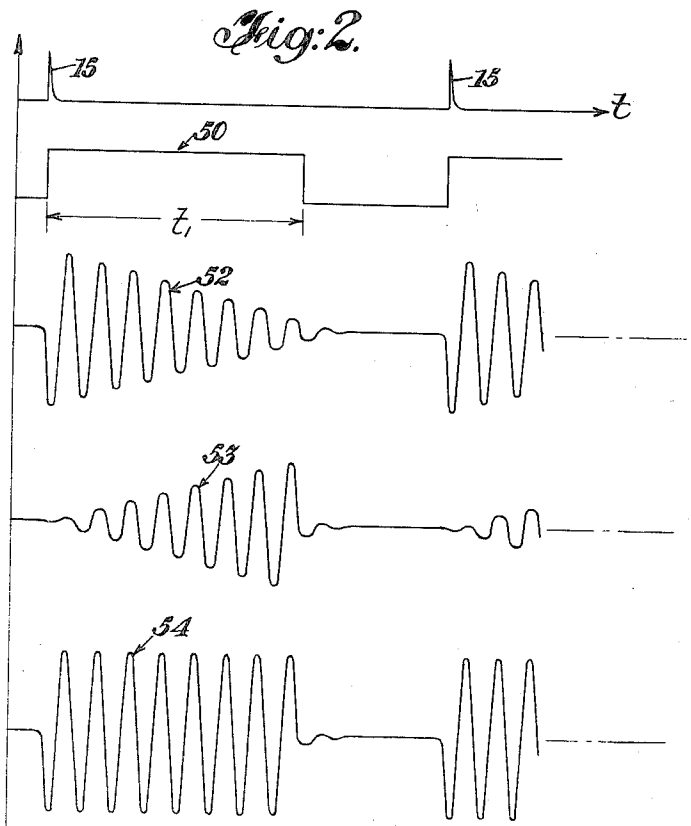
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CONSTANT AMPLITUDE WAVE TRAIN GENERATOR

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CONSTANT AMPLITUDE WAVE TRAIN GENERATOR

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This invention relates to radio impulse systems and more particularly to a system for producing a wave train of oscillations from which impulses of substantially constant amplitude can be produced.

In my copending application entitled "Timing system," Serial No. 466,557 filed November 23, 1942, now Patent No. 2,438,904, dated April 6, 1948, I disclose methods and means for producing by shock excitation in response to a synchronizing impulse, a damped wave train and how I compensate by different means the decay of the oscillations thereof so as to produce a plurality of oscillations of substantially constant amplitude.

It is an object of this invention to provide an additional method and means to produce in response to an electrical impulse a wave train of oscillations of substantially constant amplitude.

Another object of my invention is to provide a method and means to generate and control the duration of a wave train of oscillations having substantially constant amplitude.

The method of this invention for compensating for the decay of the oscillations of a damped wave train is characterized by first generating a second wave train of oscillations, the rate of build-up or increase of the amplitudes thereof being controlled according to the decay of the oscillations of the damped wave train. This second series of oscillations is combined with the damped wave thereby producing a wave having a series of substantially constant amplitude oscillations. The duration of the constant amplitude wave is determined by controlling the generation and combining action of the second series of oscillations by use of an impulse the duration of which is equal to the desired length of the constant amplitude wave. This impulse is used so that the wave-front thereof shock excites a tuned circuit to initiate generation of the damped wave train and simultaneously to open a "gate" such as by rendering a vacuum tube conductive to permit the combining action. The trailing edge of the impulse is used to close the "gate" and thereby discontinue the combining action at the end of the desired interval.

For a further understanding of the method and of means by which the method may be practiced, reference may be had to the following detailed description to be read in connection with the accompanying drawings, in which:

Fig. 1 is a schematic illustration of a circuit in accordance with this invention; and

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Fig. 2 is a graphical illustration showing the steps of operation.

Referring to Fig. 1, the controlling impulse may be produced by an impulse generator 10 or it may be derived from any other suitable impulse source. The impulse produced by the generator 10 is indicated at 12. The generator may be of any known form such as a multivibrator, for example, having an operating characteristic of returning to one state of operation a predetermined interval after an operation changing the operation of the circuit. For purposes of illustration, however, I show the generator 10 as being of the character employing a gas discharge tube 14 which may be of the type known by the trade-mark "Thyratron." A synchronizing pulse input 16 is connected through coupling condenser 17 and a resistor 18 to the grid 20 of the tube 14. The source of synchronizing pulses 15 (Fig. 2) may comprise any suitable source and may, for example, comprise pulse energy from a pulse modulator such as employed in a radio detection apparatus.

The tube 14 is provided with a suitable negative bias imposed upon the grid 20 through a resistor 22. The anode 24 of the tube is provided with a positive bias through a resistor 25. The cathode 26 is self-biased by a resistance-capacitance circuit 27 which connects the cathode to ground. The pulses applied to the grid 20 control initiation of operation of the tube while the self-biasing of the cathode 26 is arranged to maintain operation for a desired length of time. This operation produces the impulse 12 which, as shown in Fig. 1, I use to control the initiation of the damped wave 52 (Fig. 2) and the duration of the compensating effect (wave 53) for the decay of the oscillations thereof.

The constant amplitude wave generating means is built about a vacuum tube 30 having an anode 31, a suppressor grid 32, a screen grid 33, a grid 34 and a cathode 35. The output circuit 29 of the generator 10 is connected through a coupling condenser 36 to the suppressor grid 32 which is biased negatively through a resistor 38. This negative voltage on the suppressor grid normally biases the tube 30 to cut-off. The anode 31 has connected thereto a tuned oscillatory circuit 40 comprising an inductance coil 41 and a condenser 42. The tuned circuit 40 connects the anode 31 to a positive potential source through a resistor 44. The grid 34 is connected to a second circuit 45 having an inductance coil 46 adjustably coupled with the coil 41.

In operation, the impulse 12 is applied to the

suppressor grid 32 thereby overcoming the normal negative bias thereon thereby producing in effect a zero or neutral potential on the suppressor grid as indicated by the line 48 on pulse 12. This suppressor grid potential or rather the conductive period of the tube 30 is shown in Fig. 2 as a rectangular pulse 50 having a duration t_1 . When the negative bias on the suppressor grid is eliminated by the application of the impulse 12, the opening of the tube to conduction produces a sudden drop in potential on the anode 31 thereby shock exciting the circuit 40 into oscillation. This oscillation of the circuit 40 produces a damped wave 52. The inductive coupling of the coils 41 and 46 causes a second oscillation 53 to be produced in the circuit 45, the building-up of which may be made to correspond to the decay of the oscillations of the damped wave 52 by proper adjustment of the coupling relationship of the coils and the gain of the tube 30.

During the time interval t_1 , while suppressor grid 32 is subjected to the potential of the impulse 12, the potential of the suppressor grid is such as to maintain the tube open for conduction. The oscillations occurring in the coil 46 of the circuit 45 are introduced into the tube at the grid 34 and combine with the oscillating potential applied on the anode by the oscillating action of the circuit 40.

This combining action results in a series of oscillations 54 the amplitudes of which are substantially constant for the duration of the time interval t_1 . At the termination of the impulse 12, the normal negative cut-off bias on the suppressor grid is re-established thereby closing the tube to conduction. This means that the oscillations built-up in the circuit 45 can no longer combine at the anode 31 with the oscillations from the circuit 40 and the constant amplitude oscillations 54 terminate abruptly. Some small oscillation may continue after the termination of the constant amplitude oscillations 54 due to the trailing portion of the damped wave 52.

It will be readily apparent from the foregoing description that the feed-back arrangement of the circuit provides a means for adjusting the degree of compensation required for overcoming the decay occurring in the damped wave. It will be understood, of course, that this compensation may be varied as desired and, in fact, may produce output oscillations having increasing amplitudes.

As disclosed in my aforesaid copending application, the constant amplitude oscillations 54 may be used for the generation of calibrating pulses for an oscillograph. This may be accomplished by clipping the constant amplitude wave so as to produce a wave of rectangular form which when applied to a differentiating circuit will produce alternate positive and negative pulses of constant amplitude, the positive pulses corresponding to the wave front and the negative pulses corresponding to the trailing edges of the rectangular portions of the wave. These pulses may be used directly for calibration purposes or they may be passed through a class "C" amplifier to produce unidirectional pulses either positive or negative as may be desired.

As indicated in Fig. 2, a wave of oscillations 54 is produced in response to each impulse 15. Thus, the calibration pulses produced from the oscillations 54 may be used for calibrating an oscillograph of the radio detection apparatus. For a further understanding of radio detection apparatus to which this invention is applicable, ref-

erence may be had to my copending application entitled "Delay circuit," Serial No. 464,008, filed October 31, 1942.

While I have shown and described a specific apparatus for carrying out the method of my invention, it will be understood that the apparatus may be modified and that other apparatus may be used for practicing the method without departing from this invention. For example, the impulse 12 applied to the suppressor grid 32 may instead be applied to a different control element. It is to be understood, therefore, that the form herein shown and described is to be regarded as illustrative of the invention only and not as limiting the objects thereof and appended claims.

What is claimed is:

1. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising a high quality tuned circuit, means for shock exciting said tuned circuit to generate a damped wave train therein, a second circuit including a source of negative potential inductively coupled to said tuned circuit, a vacuum tube having a plurality of electrodes including an anode and a grid, the anode being connected to said tuned circuit and the grid being connected to said second circuit, whereby oscillations tend to build up in said tuned circuit as shock excitations diminish so that the decay of said shock oscillations in said circuit is compensated.

2. The system defined in claim 1 wherein the coupling means between the tuned circuit and the second circuit is adjustable to control the rate of increase in amplitude of the oscillations built up thereby.

3. The system defined in claim 1 wherein said means for shock exciting said circuit includes a third electrode in said tube normally biased to cut-off, and means for applying to said third grid a controlling impulse of a given duration, said impulse operating to excite said tuned circuit to oscillate and to control for the duration of the impulse the combining action of the oscillations produced in the second circuit with oscillations produced by the tuned circuit.

4. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising means to produce in response to a synchronizing pulse an impulse of a given duration, a vacuum tube having anode, grid and suppressor grid electrodes, a tuned oscillatory circuit connected to said anode, a second circuit provided with a source of negative potential connected to said grid, means to inductively couple said second circuit to said tuned circuit, means to normally bias said tube to cut-off, means connecting the output of said impulse generating means to the suppressor grid so that said impulse is adapted to render said tube conductive and thereby shock excite said tuned circuit to oscillate, and thereby produce a damped wave, and an output connection for said anode the conduction of said tube operating to combine at said output connection the oscillations produced in said second circuit with oscillations produced in said tuned circuit, the passage of the oscillations from said second circuit operating to invert the oscillations so that they compensate for the decay of the oscillations of said damped wave.

5. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising an electron discharge device having two separate input circuits, a tuned

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oscillatory circuit and a source of energy coupled in the output circuit of said device, a source of impulses, means for applying impulses from said source to one of said input circuits to vary the conductance of said device whereby damped oscillations are generated in said tuned circuit, means coupled between said tuned circuit and the other of said input circuits for deriving oscillations having a rising characteristic corresponding to the decaying characteristic of the oscillations in said tuned circuit.

6. The system according to claim 5, and in which the means for coupling is adjustable.

7. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising a vacuum tube to generate a damped wave train of oscillations, said tube having an anode, a cathode, and a plurality of grids, a tuned oscillatory circuit connected with the anode, adjustable coupling means for connecting the oscillatory circuit with one grid, a source of impulses, and a circuit for applying impulses from said source to another grid.

8. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising a vacuum tube to generate a damped wave train of oscillations, said tube having a cathode, an anode and suppressor, screen and control grids, a tuned oscillatory circuit connected with the anode, adjustable coupling means connecting the oscillatory circuit with said control grid, a source of impulses, and means for applying impulses from said source to said suppressor grid.

9. A system for producing a wave train having a series of oscillations of substantially constant amplitude comprising a high quality tuned circuit,

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means for shock exciting said tuned circuit to generate a damped wave train therein, a second circuit inductively coupled to said tuned circuit, a vacuum tube having a plurality of electrodes including an anode and a grid, the anode being connected to said tuned circuit and the grid being connected to said second circuit, whereby oscillations tend to build up in said tuned circuit as shock excitations diminish so that the decay of said shock oscillations in said circuit is compensated.

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