

July 18, 1939.

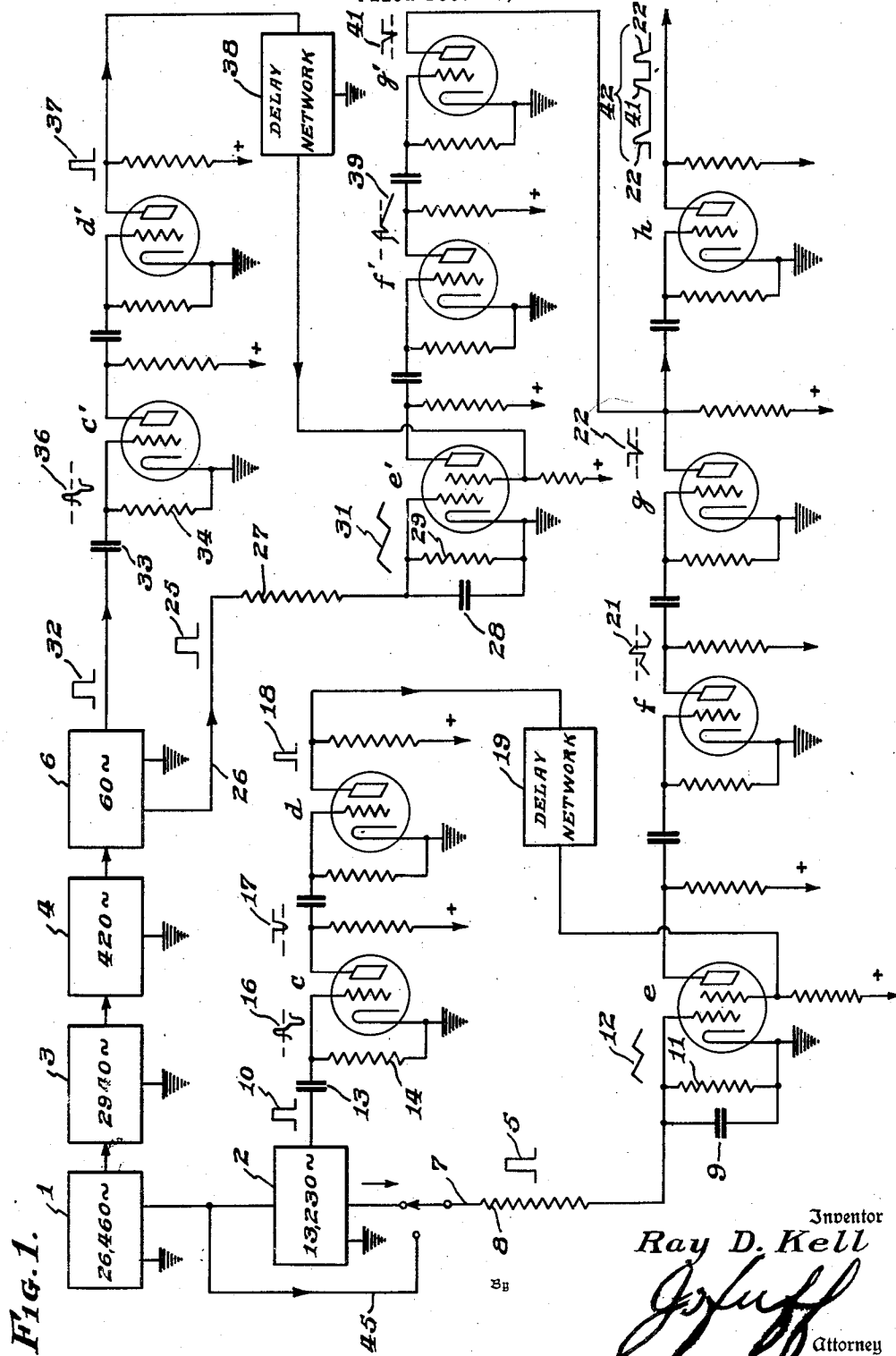
R. D. KELL

2,166,688

TELEVISION APPARATUS

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FIG. 2.

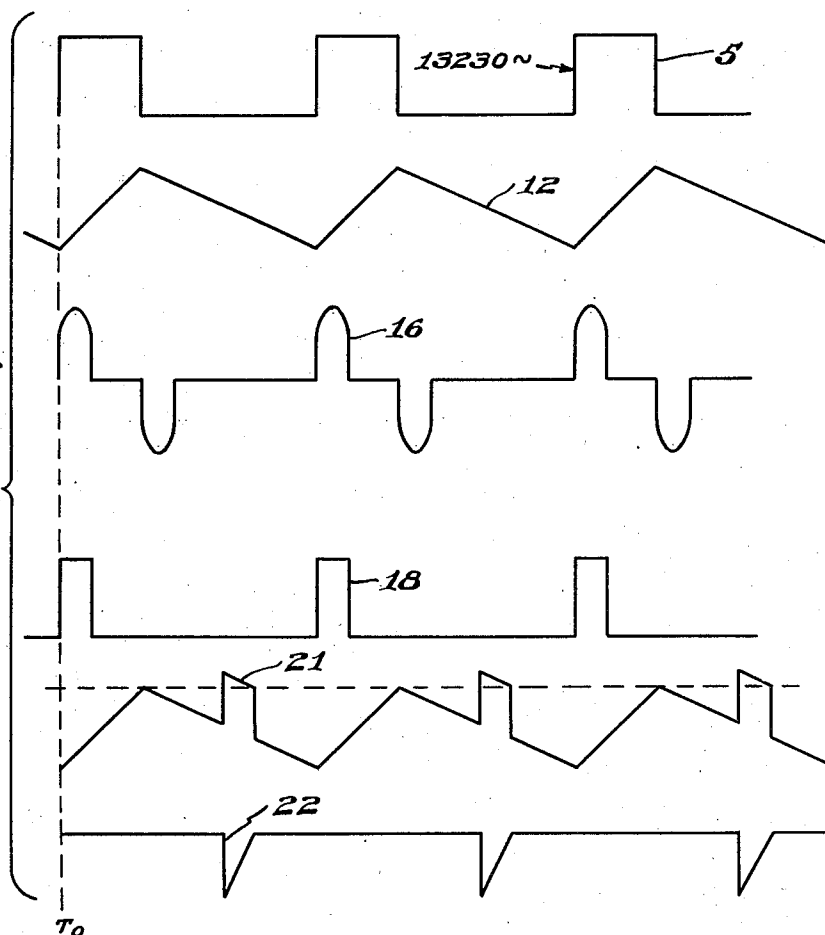
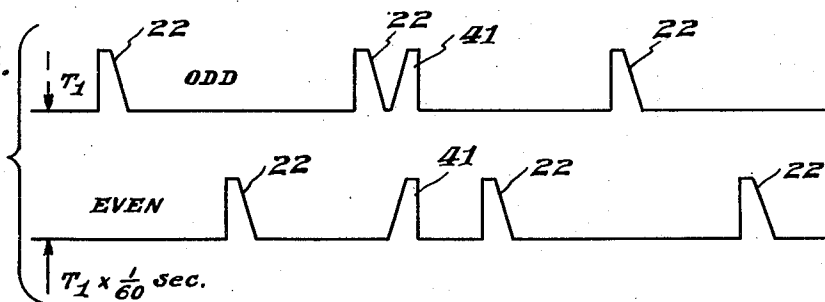


FIG. 4.



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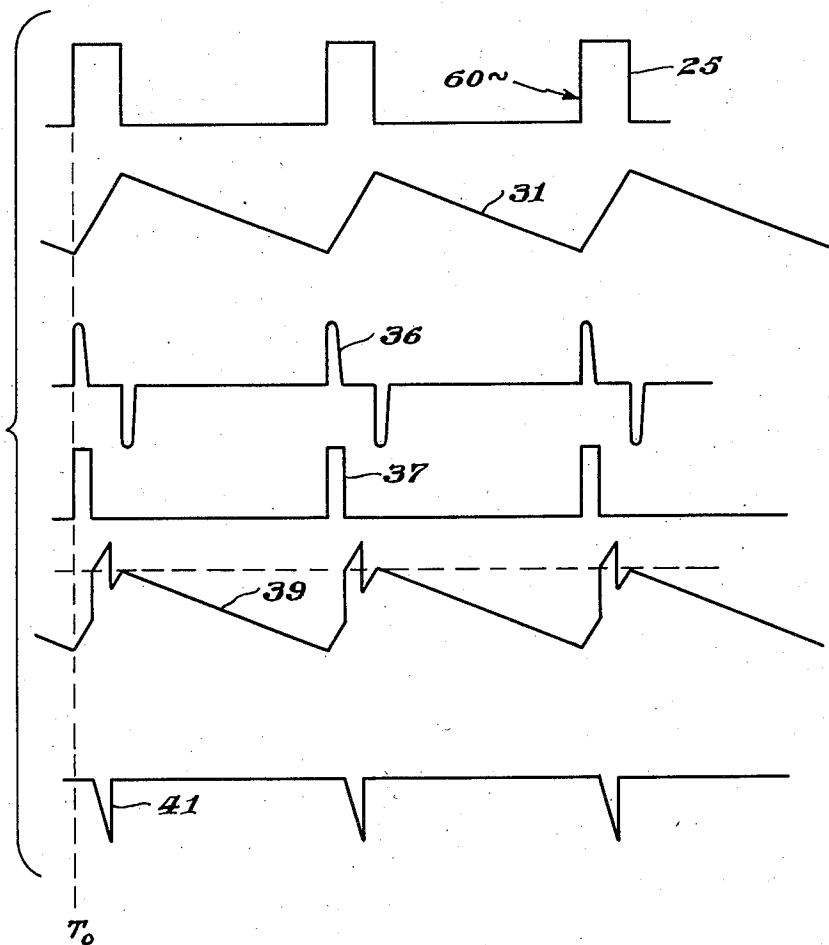
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Fig. 3.



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UNITED STATES PATENT OFFICE

2,166,688

TELEVISION APPARATUS

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Application December 18, 1937, Serial No. 180,502

7 Claims. (Cl. 250—36)

My invention relates to the production of electrical impulses having a certain desired wave shape, and particularly to a method and apparatus for producing synchronizing impulses for use in a television system.

In application Serial No. 180,493, filed December 18, 1937, in the name of A. V. Bedford, entitled Television systems and assigned to the Radio Corporation of America, there is described and claimed a television system in which one group of synchronizing impulses (the horizontal impulses, for example) have a steep front side and a gradually sloping back side, while the other group of synchronizing impulses (the vertical or framing impulses, for example) have a steep back side and a gradually sloping front side. These synchronizing impulses are passed through a differentiating circuit in the television receiver whereby a steep "front" produces a sharp impulse of one polarity and a steep "back" produces a sharp impulse of the opposite polarity. Thus, the horizontal and vertical synchronizing impulses may be separated by amplitude selection (as by the use of clipping tubes) for holding the horizontal and vertical deflecting circuits of the receiver in synchronism with scanning at the transmitter. An object of my invention is to provide an improved method of and means for producing synchronizing impulses of the above-described character.

A further object of my invention is to provide an improved method of and means for producing electrical impulses which have one side substantially perpendicular, while the other side is gradually sloping.

In a preferred embodiment of my invention, the desired impulse is obtained by producing a rectangular impulse and a saw-tooth wave and adding them whereby a portion of the combined wave appears as an impulse with perpendicular sides and a sloping top. The combined wave is then clipped at a level such that only the upper part of this portion with the sloping top appears in the output circuit. The result is an impulse with one very steep side and one gradually sloping side.

Whether the steep side of an impulse is the "front" side or the "back" side is determined by whether the rectangular impulse is added on the back side or the front side of the saw-tooth wave. The relation of the rectangular impulse with respect to the saw-tooth wave may be determined by the amount either the rectangular impulse or the saw-tooth wave is delayed before the two are added.

The invention will be better understood from the following description, taken in connection with the accompanying drawings, in which

Figure 1 is a circuit and block diagram of one embodiment of my invention,

Figure 2 is a group of curves which show how the horizontal synchronizing impulses are obtained,

Figure 3 is a group of curves which show how the vertical synchronizing impulses are obtained, and

Figure 4 is a group of curves showing the complete synchronizing signal.

Referring to Fig. 1, I have shown one embodiment of my invention as applied to a television system which produces a 441-line interlaced picture. It will be understood that the apparatus shown in Fig. 1 is located at the television transmitter and supplies horizontal and vertical synchronizing impulses to the deflecting circuits of both the cathode ray transmitter tube and the cathode ray tube at the receiver.

The horizontal and vertical synchronizing impulses are derived from a common source such as a multivibrator or other suitable oscillator 1. A second multivibrator 2 divides the frequency of the oscillator 1 by two to produce impulses at the line frequency, 13,230 cycles per second in the specific system being described.

A chain of multivibrators 3, 4 and 6 divide the frequency of oscillator 1 to produce impulses occurring at the picture frame frequency of 60 per second. It will be understood that the 60 cycle and 13,230 cycle impulses having the desired odd-line relationship for interlacing may be obtained in any other suitable way, as by means of a rotating disc having suitable openings therein, as described and claimed in Patent No. 2,152,234 issued in the name of R. C. Ballard, and assigned to the Radio Corporation of America, or by means of blocking oscillators as described and claimed in application Serial No. 726,258, filed May 18, 1934, in the name of A. V. Bedford, entitled Television systems, and assigned to the Radio Corporation of America.

The portion of the circuit which produces the horizontal synchronizing impulses will first be described. The saw-tooth voltage wave, which is to be combined with a rectangular impulse, is produced in this specific example by supplying a rectangular voltage impulse, indicated at 5, from the oscillator 2, over a conductor 7 and through a resistor 8 to a condenser 9. The condenser 9 is connected across the input electrodes of a screen grid tube *e* and is shunted by a resistor 11,

the resistor 11 having a high resistance, such as one megohm, as compared with the resistance of resistor 8. In practice, the resistor 8 may be the plate impedance of one of the multivibrator tubes.

Condenser 9 is alternately charged and discharged a small amount through resistor 8, whereby a saw-tooth voltage wave, indicated at 12, is impressed upon the control grid of tube e. Stated differently, the circuit 9, 11 integrates the impulses 5 to produce the saw-tooth wave 12.

The rectangular voltage which is to be combined with the saw-tooth wave is produced in this specific example by supplying rectangular voltage impulses, indicated at 10, from oscillator 2 to a vacuum tube c through a differentiating circuit comprising a condenser 13 of small capacity and a resistor 14 of comparatively low resistance, the resistor 14 being connected across the input electrodes of the tube c. It will be understood that impulses 10 occur at the rate of 13,230 per second. A differentiating circuit of this character and its action are described and claimed in Patent No. 2,132,655, granted October 11, 1938 to J. P. Smith, entitled System for producing electrical impulses, and assigned to the Radio Corporation of America.

The derivative of impulse 10 appears on the grid of tube c, as indicated at 16. Since tube c is adjusted to act as a "clipping tube", only the upper impulse portion of wave 16 passes through the tube. This portion appears inverted in the plate circuit of tube c, as indicated at 17, and is impressed upon a clipping tube d whereby a square topped voltage wave appears in the output of tube d, as indicated at 18. It will be noted that, by differentiating and clipping, the impulse 5 has been narrowed but not delayed.

The tubes c and d, and other clipping tubes to be described, are adjusted to function as clipping tubes by selecting such values for the grid condensers and grid leak resistors that the tubes are grid leak biased. That is, the charge on the grid condenser holds over a substantial amount between rectangular impulses to bias the tubes negatively the desired amount, as described in the above mentioned Smith application.

Impulses 18 are combined with the saw-tooth waves 12 after impulses 18 have been suitably delayed in a delay network 19 to make the two groups of signals combine in the correct time relation. The desired addition of signals is obtained by impressing the delayed impulses 18 upon the screen grid of tube e. The combined signal, after being inverted by a tube f, is of the character indicated at 21.

Signal 21 is supplied to a clipping tube g, which clips signal 21 at the level indicated by the dotted line to produce the desired impulse, indicated at 22, having a steep front side and a gradually sloping back side.

The delay network 19 may be of any suitable design, such as a conventional capacity-inductance network of recurrent sections, or it may be a network comprising vacuum tubes and wave shaping networks of the character described in the above mentioned Smith application Serial No. 8,659.

Referring now to that portion of the circuit which produces the vertical synchronizing impulses having a steep back side and a sloping front side, rectangular voltage impulses occurring at the framing frequency of 60 cycles per second and indicated at 25 are supplied from oscil-

lator 6 over a conductor 26, through a resistor 27 to a condenser 28 which is connected across the input electrodes of vacuum tube e'. Condenser 28 is shunted by a resistor 29 having comparatively high resistance. Thus, a saw-tooth voltage wave is supplied to the grid of tube e' as indicated at 31. It will be seen that tube e' corresponds to tube e in the horizontal synchronizing circuit. Similarly, the vacuum tubes c', d', f' and g' now to be described correspond to tubes c, d, f and g in the horizontal synchronizing circuit.

The rectangular voltage impulse to be added to the saw-tooth 31 is obtained by taking from oscillator 6 a rectangular voltage impulse indicated at 32, which occurs at the frame frequency of 60 per second, and supplying it to a differentiating circuit comprising a condenser 33 of small capacity and a resistor 34 of comparatively small resistance. The resulting signal indicated at 36 appearing on the grid of tube c' is clipped by tube c' as indicated by the dotted line, and after further clipping by tube d', appears in the plate circuit of tube d' as a narrowed rectangular impulse indicated at 37.

Impulses 37 are delayed by a delay network 38 which may be of the same type as delay network 19. The delayed impulses 37 are added to the saw-tooth waves 31 by impressing them upon the screen grid of tube e'. The amount that impulses 37 are delayed is such as to make them add on the front side of the saw-tooth wave rather than on the back side, as is the case in the horizontal synchronizing circuit. Thus, after being inverted by tube f', the combined signal appears in the output circuit of tube f', as indicated at 39. This signal is then clipped by the tube g', as indicated by the dotted line, to produce the desired signal having a steep back side and a sloping front side, as shown at 41.

The vertical synchronizing signals 41 and the horizontal synchronizing signals 22 are combined in the common plate circuit of tubes g and g', the combined signals then have their sharp peaks clipped off by a clipping tube h whereby there appears in the output circuit of tube h a signal of the character shown at 42 and shown more clearly in Fig. 4.

In Fig. 4, the curve marked "odd" and the curve marked "even" represent the same signal (the output of tube h) but the "even" signal occurs $\frac{1}{60}$ second later than the "odd" signal. The signals 22 and 41 are the horizontal and vertical synchronizing impulses, respectively. From a comparison of these two curves, it will be seen that the steep sides of the "even" horizontal impulses are displaced $\frac{1}{2}$ scanning line with respect to the steep sides of the "odd" horizontal impulses whereby an interlaced picture is produced.

The way in which the horizontal synchronizing signals are produced will be better understood by referring to Fig. 2, where the time relation of the several signals is shown, curves corresponding to those in Fig. 1 having the same reference numerals.

It will be seen that the desired final impulses 22 are obtained by adding the rectangular impulses 18 (derived from impulses 5) and the saw-tooth waves 12 in such time relation that, after the combined signal 21 has been clipped at the level indicated by the dotted line, the resulting signal 22 has a steep "front" and a sloping "back". It will be apparent, by comparing the impulses 18 and the combined signal 21, that the impulses 75

18 are delayed enough to make them fall on the back side of the saw-tooth wave 12.

Also referring to Fig. 3, there is shown the time relation of the several signals which are produced to obtain the vertical synchronizing impulses. In this figure, curves corresponding to those in Fig. 1 are indicated by the same reference numerals. An inspection of curve 39 shows that the rectangular impulse is delayed just enough to make it fall on the "front" side of the saw-tooth, rather than on the "back" side of the saw-tooth as in Fig. 2, whereby the combined signal may be clipped at the level indicated by the dotted line to produce the vertical synchronizing impulses 41 having a steep "back" side and a gradually sloping "front" side.

While I have shown and described one way of producing saw-tooth waves and one way of producing rectangular impulses, it is to be understood that such waves and impulses may be produced in any suitable manner.

Instead of having the saw-tooth waves 12 occur at the horizontal deflecting frequency, they may be produced at a multiple frequency. For example, the conductor 7 may be switched to a conductor 45 leading to the main oscillator 1, whereby saw-tooth waves occurring at the rate of 26,460 per second are supplied to the tube 2. In this case an impulse 18 is added to every other saw-tooth wave, instead of to every saw-tooth wave.

It may be noted that generally the duration of the impulse 18 in the horizontal synchronizing circuit is made approximately the same as the duration of the impulse 37 in the vertical synchronizing circuit, although, of course, this is not essential.

It will be understood that while I have described my invention as applied to an interlaced scanning system, it is not so limited. As indicated in Fig. 4, if the system is designed to provide the so-called "odd-line" interlaced scanning described, the steep sides of the horizontal synchronizing impulses occurring at time $T_1 + \frac{1}{2} \text{ sec.}$ should fall half-way between the steep sides of the horizontal synchronizing impulses occurring at T_1 sec.

I claim as my invention:

1. The method of producing periodically recurring impulses each having a front side which has a different slope than its back side, said method comprising producing an impulse having a back side of a certain slope, producing an impulse having a front side of a different slope, combining said impulses to produce a combined wave which has a portion having a back side with a slope determined by said certain slope and having a front side with a slope determined by said different slope, and passing only said portion to an output circuit.

2. The method of producing recurring impulses each having a front side and a back side, one side being steeper than the other side, said method comprising producing saw-tooth waves, producing substantially rectangular waves, combining said saw-tooth waves and said rectangular waves whereby a portion of the combined wave has a greater amplitude than the saw-tooth wave, and passing only said portion to a utilization circuit.

3. The method of producing synchronizing impulses which comprises producing saw-tooth waves each having a front side and a back side, producing substantially rectangular impulses each having a duration less than that of one side

of said saw-tooth waves, combining said waves and said impulses to produce a combined portion of greater amplitude than said saw-tooth waves, and passing only said portion to a utilization circuit.

4. The method of producing synchronizing impulses which comprises producing saw-tooth waves, producing substantially rectangular impulses each having a duration less than that of one of said saw-tooth waves and of such amplitude that when combined with said saw-tooth waves portions of greater amplitude than the amplitude of said saw-tooth waves are produced, combining said waves and said impulses and passing only said portions to a utilization circuit.

5. A generator of periodically recurring impulses comprising means for producing periodically recurring impulses each having a front side and a back side, one of said sides having a certain slope, means for producing other periodically recurring impulses each having a front side and a back side, the side opposite said one side having a slope different than said certain slope, means for adding said first mentioned impulses and said second mentioned impulses whereby a combined wave is produced having a portion with one side which has a slope determined by said certain slope and with the opposite side having a slope determined by said different slope, and means for passing only said portion to an output circuit.

6. A generator of synchronizing impulses comprising means for producing saw-tooth waves each having a front side and a back side, means for producing substantially rectangular impulses each having a duration less than one side of one of said saw-tooth waves, means for so combining said waves and said impulses that said impulses add on one side of said waves to produce periodically recurring portions each having a slope on one side determined by said saw-tooth waves and a slope on the other side determined by said impulses, and means for passing only said portions to an output circuit.

7. In a television transmitter, a generator of comparatively high frequency horizontal synchronizing impulses and of comparatively low frequency vertical synchronizing impulses, said generator comprising means for generating saw-tooth waves occurring at a rate at least as high as said high frequency, each of said waves having a front slope and a back slope, means for generating substantially rectangular impulses of less duration than one of said slopes, means for adding said impulses to said saw-tooth waves in such relation that each impulse falls on said one slope of a saw-tooth wave to produce a combined portion of greater amplitude than that of the saw-tooth waves, means for passing only said portion to an output circuit, means for generating saw-tooth waves occurring at a rate at least as high as said low frequency, each of said low frequency waves having a front slope and a back slope, means for generating substantially rectangular impulses of less duration than the slope that is the opposite of said one slope of the high frequency waves, means for adding said last-mentioned impulses to said low frequency waves in such relation that each impulse falls on said opposite slope to produce a combined portion of greater amplitude than that of the low frequency saw-tooth waves, and means for passing only said last-mentioned portion to said output circuit.

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