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PULSE GENERATION METHOD

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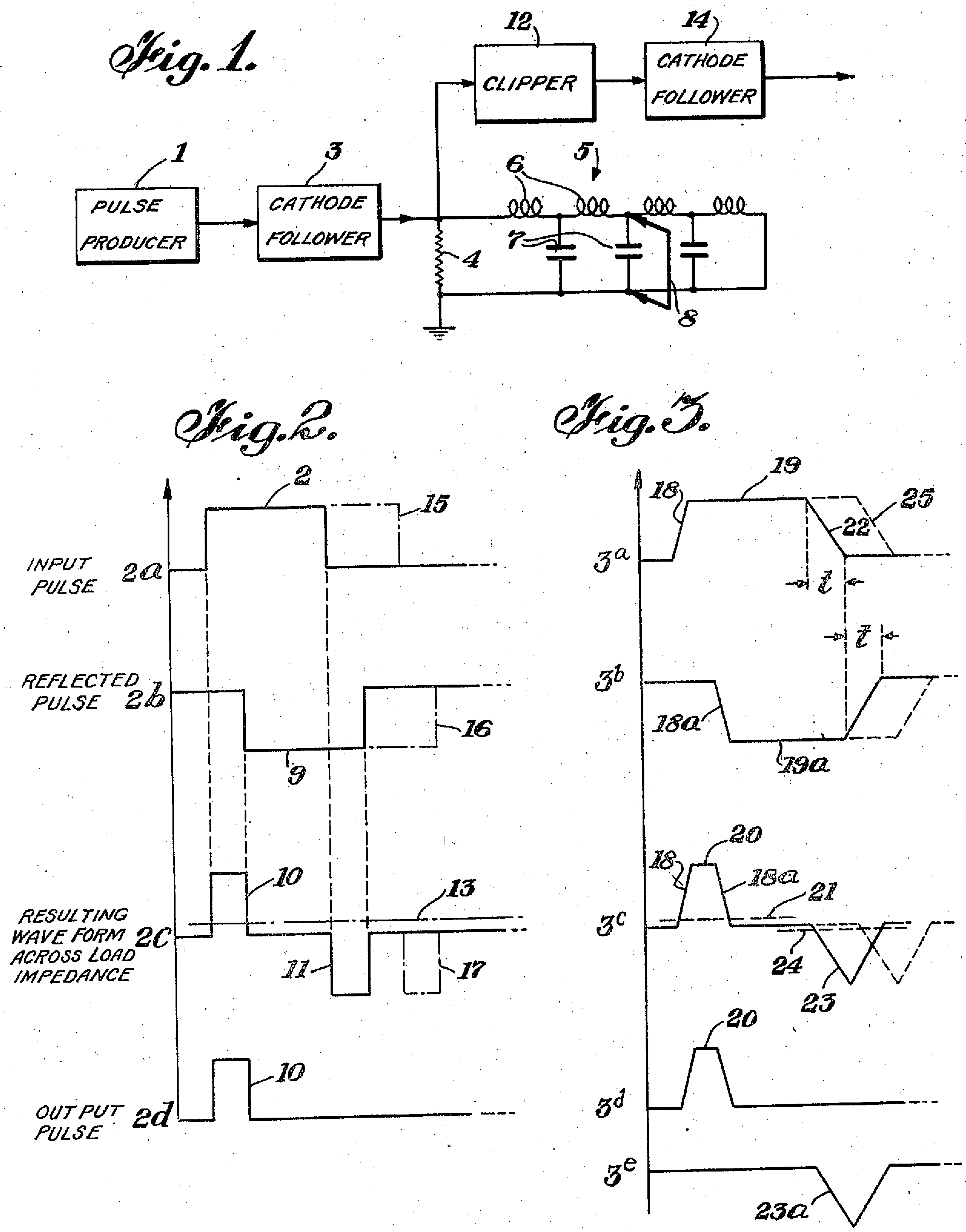

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PULSE GENERATION METHOD

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1 Claim. (Cl. 178—44)

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This invention relates to the generation of electrical pulses and more particularly to the generation of symmetrically shaped electrical pulses.

In multi-channel pulse systems and in the production of synchronizing pulses for television, as well as the production of pulses in other pulse systems, it is often desirable to produce symmetrical pulses of a given duration and/or of a given steepness for the leading and trailing edges thereof. It is not always possible to obtain a consistency of duration or symmetry for pulses produced, especially where their production is dependent on a source of pulses, the duration and/or repetition rate of which vary.

It is an object of my invention to provide a method and means for producing a substantially symmetrically shaped pulse from another pulse equal to or greater than the duration of the desired pulse.

Another object of the invention is to provide a method and means for producing substantially symmetrically shaped pulses having a given duration and/or a given steepness of slope for the leading and trailing edges thereof, from a source of pulses regardless of any variation that may occur in the duration and/or repetition rate of the pulses of such source.

According to a feature of my invention use is made of the properties of a short circuited passive network or other pulse reflecting means to produce pulses whose duration is determined by the retardation characteristics of the reflecting means independent of the repetition rate and duration of the input pulses. The duration of the input pulses, however, should be at least equal to the desired duration of the output pulses. The input pulse is impressed at the input end of the network and travels through the network to the short circuited portion thereof from which it is reflected. The net result of this action is the appearance of a reflected pulse at the sending end impedance possessing substantially the shape characteristics of the input pulse, but reversed in polarity and delayed by an amount equal to twice the forward delay of the network. The resulting pulse energy existing across the sending end impedance of the network is the sum of the input and reflected pulses. The sending end impedance is preferably made equal to the characteristic impedance of the line so that the reflected energy is absorbed, thereby clearing the network of reflections prior to the occurrence of the next input pulse. By suitably clipping a selected portion of the resulting pulse energy an

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output pulse of the desired duration and polarity is obtained.

A further feature of the invention is the selection of slope for the leading and trailing edges of the output pulse. This is controlled by the slope of the leading or trailing edge of the input pulse, as the case may be. As will be described in further detail hereinafter the leading and trailing edges of the output pulses are caused to correspond directly to the steepness of the slope of either the leading or trailing edge of the input pulses, depending upon from which of the two pulse portions resulting across the input impedance, the output pulse energy is obtained.

The above and other objects and features of the invention will become more clear upon consideration of the following detailed description to be read in connection with the accompanying drawings, in which,

Fig. 1 is a schematic wiring diagram with parts in block form of an embodiment of my invention, and,

Figs. 2 and 3 are graphical illustrations used in explaining the operation of the embodiment shown in Fig. 1.

The pulse producer 1 of the system may comprise any source of pulses available so long as the pulses thereof are of a duration equal to or greater than the duration of the desired output pulses. In graph *2a* of Fig. 2 a rectangularly shaped pulse 2 is shown by way of example as the character of the pulses obtained from the producer 1. These pulses are applied to a cathode follower, 3 the output circuit of which contains an impedance load 4. Connected across the impedance load 4 is a passive network or artificial delay line 5 comprising a series arangement of inductance coils 6 and parallel arrangement of condensers 7. The load impedance 4 together with the equivalent cathode follower impedance, as hereinbefore stated, is preferably chosen so as to match the characteristic impedance of the network 5. For controlling the retardation characteristics of the network a shorting device 8 is provided for adjustment or selective connection at points along the length of the network. For any input pulse the energy thereof travels along the network until it comes to a short circuited portion thereof, such as formed by the short circuiting device 8. The short circuited portion reflects the pulse energy resulting in its delayed re-appearance across the load impedance 4 but with the polarity thereof reversed. This delayed reversed reflection pulse effect is indicated by pulse 9 in graph **2b**. As shown in graph **2c**, the pulses 2 and 9 add algebraically thereby producing a positive pulse 10 and a negative pulse 11 each of which corresponds in duration to twice the forward retardation effect of the network. It will also be observed that the leading and trailing edges of the positive pulse 10 correspond exactly to the leading edges of the input pulse 2 and the reflected pulse 9, respectively. Likewise, the leading and trailing edges of negative pulse 11 correspond to the trailing edges of pulses 2 and 9.

To obtain the pulse energy of positive pulse 10 or negative pulse 11 whichever is desired, a clipper 12 is provided across the load impedance 4 and is provided with a suitable bias for clipping the desired pulse energy from the resulting wave indicated by graph 2c. In graph 2c, the clipper 12 is indicated as having a threshold clipping level 13 whereby energy of the positive pulse 10 is obtained as shown in graph 2d. If desired, the clipper may be provided with a cathode follower 14, whereby output pulses may be obtained at a lowered output impedance.

Assume, for example, that the input pulses vary in duration between the solid line and the dot-dash lines indicated for pulse 2 of graph 2a. The reflected pulses 9 of graph 2b will likewise be varied as indicated at 16. This variation does not alter the pulse width or position of the positive pulse 10. The negative pulse, however, is shifted in time in accordance with the variation in width of the input pulse, but its width remains the same, as indicated at 17.

Where a given slope is desired for the output pulse as indicated by graphs 3d and 3e of Fig. 3, the leading or trailing edge of the input pulse is caused to have the desired slope. As shown in graph 3a the leading edge 18 of the input pulse 19 is given the desired slope for output pulse 20a. The leading edge 18a of the reflected pulse 19a of graph 3b corresponds substantially directly to the slope of the leading edge 18 of input pulse 19. The summation of the two pulses result in positive pulse 20, whose leading edge is the same in slope as the leading edge 18 and whose trailing edge is the same in slope as leading edge 18a. By clipping the pulse 20 at a level 21 an output pulse 20a is obtained as desired.

It will be observed that by shaping the leading or trailing edge of the input pulse and selecting a certain retardation characteristic for the network 5 symmetrically triangular pulses can be obtained. This is illustrated by the trailing edge 22 of input pulse 19, graph 3a. As shown in graph 3b, the total retardation of travel through the network to and from the short circuited device 8 is taken equal to the duration of the trailing edge 22 as indicated by the time interval *t*. The summation of the pulses 19 and 19a therefore results in a negative pulse 23 of symmetrical triangular shape, the leading edge thereof corresponding to the trailing edge 22, while the trailing edge thereof corresponds to the trailing edge of pulse 19a. The triangular pulse is obtained by clipping the resulting pulse energy along a level 24 thereby producing output pulse 23a shown in graph 3e. The slopes of the pulse 23a, of course, may be varied in steepness by varying the steepness of the trailing edge of the input pulse. It will also be observed that symmetrical triangular pulses may be obtained from the leading edge of the input pulse by proper selection of the retardation characteristics of network 5 with respect to the duration of the leading edge of the input pulse.

Where the input pulse varies in duration as indicated in graph 3a by broken lines 25, no effect on the resulting negative pulse is obtained other than a corresponding displacement in time.

In pulse producing devices such as, for example, a multivibrator, there is usually a variation in the pulse duration of the output pulses for variation in repetition rate of these pulses, due to the fact that such variation changes the mode of functioning of the pulse producing circuit. Such variation in repetition rate, however, does not effect the output of the circuit shown in Fig. 1 since each output pulse is the direct summation of its input and reflected energy.

While I have shown and described particular forms and variations of the above-described invention it should be understood that the forms herein mentioned are given by way of illustration of the invention only and not as restricting the invention as set forth in the objects and the appending claim.

I claim:

A method of producing a symmetrical triangular pulse, comprising propagating a trapezoidal pulse, the leading or trailing edge of which has a slope corresponding to the slope desired for the leading and trailing edges of said triangular pulse, adjustably reflecting the propagated pulse in reverse polarity and delaying said propagated pulse an amount no greater than the duration of the leading or trailing edge of said input pulse for delayed admixture with energy of said input pulse, and obtaining the pulse energy of said resulting admixture defined by the edges of the input pulse and the reflection pulse having the steepness corresponding to said given slope.

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