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## DRAWINGS ATTACHED

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## (54) PARAMETRIC DEVICE

(71) I, LESLIE KENT WANLASS, a citizen of the United States of America, of 1700, Candlestick Lane, Newport Beach, California, United States of America, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:—

10 This invention relates to parametric devices and to circuits and methods for using the same.

Various types of parametric devices have been proposed in the past for numerous circuit applications, most commonly as amplifiers for signals in the microwave range or as binary computing elements for high speed computers. Such parametric devices produce amplification or oscillation by means of the variation of an energy storage parameter, and generally comprise an L-C resonant circuit in which the value of either the inductance or capacitance is varied at a critical time to add energy to the system. This addition of energy is called pumping and maximum energy is transferred if energy is added to the resonant circuit at the peaks of its output waveform, that is, if the pumping frequency is twice that of the output frequency and properly phased therewith. The L-C circuits of typical parametric devices utilize either a non-linear inductance element such as a saturable core having a pair of windings thereon, or one or more non-linear capacitors such as a silicon diode whose capacitance is dependent on the voltage impressed across it. In the case of a variable inductance device the pumping signal is applied to one of the windings and the other winding connected in the resonant circuit while in the case of a variable capacitance device the pumping signal is applied directly to the capacitor in the resonant circuit. Because of the inherent nature of these inductors and capacitors, previously proposed paramagnetic

devices have been restricted to very high frequency, very low power applications. Moreover, the requirement of a pumping source of twice the frequency of the output limits the use of such devices.

When properly constructed such parametric circuits are essentially self starting oscillators whose oscillations build up to a certain amplitude and then remain constant at that amplitude. Parametric oscillation is usually treated and explained in the literature in terms of Mathieu's equation. Such a treatment and explanation, together with additional explanatory material relating to parametric devices can be found in an article by E. Goto, entitled "The Parametron, a Digital Computing Element which Utilizes Parametric Oscillation" published in the August 1959 issue of The Proceedings of the IRE. As explained in that article, by making certain assumptions a curve can be plotted which has a saddle point at the origin and two spiral points which indicate the stable states of stationary oscillation and which are displaced from each other by 180°. Such a curve is shown herein in Figure 1.

In the referenced article, the author mentions that oscillation of a parametric device in the stationary state is extremely stable and states that this difficulty can be overcome, as it must in order for his binary element to operate properly, by providing means for quenching the oscillation so that the stable state condition is not reached.

According to the present invention a method of producing a regulated voltage from an unregulated AC voltage source comprises initiating oscillation of a parametric device by the unregulated voltage and transferring energy from said source to said device to build said oscillations up to and maintain them at the stable oscillation point of the device to produce a regulated voltage.

A parametric device suitable for use in apparatus for effecting voltage regulation com-

[Price 5s. 0d. (25p)]

















