modification of the embodiment of Figure 4;

Figure 8 is a schematic diagram of a second embodiment of the present invention;

Figure 9 is a schematic diagram of a third embodiment of the present invention;

Figure 10 is a schematic diagram of a fourth embodiment of the present invention; and

Figure 11 is a schematic diagram of a fifth embodiment of the present invention.

In the drawings, the convention adopted in Specification No. 1,153,901 for indicating a core is followed, that is, such a core is indicated by the use of a T-shaped iron symbol. While any of the various core structures illustrated and described in Specification No. 1,153,901 could be used in this invention, in the circuits according to this invention which have actually been built, cores similar to that shown in Figure 6 of the Specification No. 1,153,901 have been used.

Turning now to Figure 1, there is shown a typical curve illustrating the amplitude-to-phase locus of an oscillating parametric device. The abscissa represents the sine component I_s and the ordinate, the cosine component I_c. If polar coordinants R (amplitude) and ϕ (phase) are introduced in the I_s, I_c plane it can be seen that R and ϕ, respectively, indicate the instantaneous amplitude and phase of the oscillation. The saddle point at the origin indicates the exponential build-up of oscillation which is in a definite phase relation to the pumping signal. The spiral points in the Figure indicate the stable states of stationary oscillation. The choice between these two modes of stationary oscillation is effected entirely by the sign of the sine component of the small initial oscillations that exist in the circuit. An anitial oscillation of quite small amplitude is sufficient to control the mode or the phase of stationary oscillation of large amplitude which is to be used as the output signal and hence an amplifying action is obtained. A more complete treatment of the mathematical and physical phenomena involved in parametric oscillation can be found in the literature, for example the previously cited Goto article. While all of the assumptions made in the literature in order to obtain the curve shown in Figure 1 may not precisely apply to the present invention, it is believed that reference to this Figure and an understanding of it are helpful in understanding the operation of the present invention and it is therefore icluded for that purpose.

Figures 2 and 3 illustrate the relationship of the inductance of the load winding of a variable inductor constructed in accordance with the teachings of Specification No. 1,153,901 with the current applied to the control winding thereof. Figure 2 shows that the inductance presented by the load winding is at a maximum when the current in the control winding is zero and decreases in the same manner irrespective of the polarity of the current applied to the control winding. Figure 3 shows the manner in which the inductance of the load winding varies when an alternating current is applied to the control winding. Curve A plots current in the control winding versus time while curve B plots inductance of the load winding versus time As can be seen, the inductance of the load winding reaches a maximum at 0° and 180°, that is, when the control current is zero, and a minimum at 90° and 270°, that is, where the control current is at a maximum. Thus, the inductance change of the load winding is at a frequency twice that of the current applied to the control winding.

Turning now to Figure 4, there is shown a voltage regulator constructed in accordance with the present invention. A variable inductor 10 of the type described has its control winding 11 connected to a source 12 of voltage to be regulated, for example, a conventional 60 cycle/second, 120 volt power line. A capacitor 13 may be connected across the winding 11 to reduce the input surge current and correct the power factor of the unit; however, this capacitor is not required for proper circuit operation. The load winding 14 of the inductor 10 is connected in parallel with a capacitor having a value such that the LC circuit made up of the winding 14 and capacitor 15 is tuned to a frequency of 60 cycles/second. A load, represented by resistor 16 is connected across the resonant circuit 14, 15.

The circuit of Figure 4 operates in the manner set forth above. When a signal is produced by the source 12, the alternating current passing through the winding 11 causes the inductance of the winding 14 to vary at twice the frequency of the source 12, as shown in Figure 3. Because of inevitable noise, at least a component of which will be at the frequency to which the LC circuit 14, 15 is tuned, a small signal will be present in the tuned circuit. The energy transferred to the tuned circuit by the pumping action of the source 12 operating through the inductor 10 will cause this noise component to increase in amplitude until a stable point is reached, the particular stable point reached being dependent upon the sign of the sine component of the noise signal. In other words, the pumping action of the source 12, by changing the inductance of the winding 14 at twice the frequency to which the resonant circuit, 14, 15 is tuned, results in the onset of parametric oscillation. It will be observed that once the stable oscillation point is reached, variations in the amplitude of the output of the source 12 will not appreciably affect the output of the LC circuit 14, 15 because of the very large signal required to