prises a variable inductor having a magnetic core, a control winding and a load winding wound on said core, a capacitor connected to the load winding to form a resonant circuit therewith resonant at a frequency f, the arrangement being such that an AC signal of frequency f applied to the control winding changes the inductance of the load winding at a frequency of 2f, and input terminals for applying the AC signal to said control winding.

The inductance component of an L-C resonant circuit may be the load winding of a variable inductor device of the form disclosed in British Patent Specification No. 1,153,901. The theoretical considerations and operating principles of this variable inductor are described in detail in Specification No. 1,153,901. Briefly, the variable inductor disclosed in Specification No. 1,153,901 comprises a ferromagnetic core having a pair of windings thereon. The core is constructed so that it has four common regions or "legs" and two end or joining portions for magnetically coupling the common regions. The coils are wound on the end portions with their axes displaced at 90° so that normally there is no inductive coupling between them, and so that the flux components generated as a result of passing currents through the two windings are at all times in opposing relationship in two of the legs and in additive relationship in the other two legs. As a result of this construction the current in one of the windings, referred to as the control winding, generates a magnetic flux which controls the reluctance of the magnetic circuit encompassed by the second winding, referred to as the load winding, in such a manner that variations in this flux caused by variations in the current in the control winding cause the hysteresis loop of the magnetic circuit encompassed by the load winding to be effectively rotated thereby varying the inductance of the load wining. The relationship between control current and load winding inductance is shown in Figure 2.

Since, as discussed in Specification No. 1,153,901, inductance is an absolute quantity, it does not follow zero crossings of the phenomena causing it, but rather in effect provides full wave rectification of the casual phenomena. Therefore, if an alternating current is applied to the control winding of an inductor of the type described, the inductance of the load winding will be controlled in accordance with the alternating current in the control winding, but because the inductance ignores the polarity of the alternating current, the inductance change will be at twice the frequency of the alternating current applied to the control winding as shown in Figure 3. This is precisely what is required for the operation of a parametric device. Therefore, by coupling the load winding of such inductor to a suitable capacitor to form a resonant circuit, energy can be transferred to the resonant circuit by pumping the control winding with an alternating current of the same frequency as that to which the resonant circuit is tuned, that is, the output frequency.

The fact that the pumping frequency of the device is the same as the output frequency open up many new applications for the device as does the fact that it can be provided with a high power rating. It has, for example, been found that the parametric device of the present invention operates as an extremely accurate regulator at conventional power frequencies when the power line is connected to the control winding. Since, as pointed out previously, it is extremely difficult to change the amplitude of oscillation of a parametric device oscillating at a stable point, the normal variations of the line voltage use as the pumping source have no effect on the amplitude of the output from the resonant circuit. This regulator has the further advantage that because there is no direct transformer coupling between the windings, transients such as SCR spikes in the line are filtered out and the output is an almost perfect sine wave. This isolation, of course, is also present in the opposite direction, i.e., from load to line. Moreover, overloading, caused, for example, by a short in the load, will not result in current limiting as in currently available constant voltage transformers, but rather will have the effect of driving the parametric device out of its stable point and preventing it from building up again with the result that the output will be completely removed. Once the disabling condition is rectified, the circuit will immediately build up to the stable oscillation point and the regulated output voltage will be restored.

The objects and advantages previously described will become more apparent upon reference to the accompanying description and drawings in which:

Figure 1 is a curve illustrating the modes of oscillation of a parametric device in the phase plane;

Figure 2 is a curve illustrating the inductance-control current characteristic of a variable inductance device used in the present invention;

Figure 3 illustrates the variation of the inductance of such a variable inductor in response to an AC control current;

Figure 4 is a schematic diagram of a first embodiment of the present invention;

Figure 5 is a schematic diagram of a first modification of the embodiment of Figure 4;

Figure 6 is a schematic diagram of a second modification of the embodiment of Figure 4;

Figure 7 is a schematic diagram of a third