Nov. 21, 1950 G. HEPP 2,530,611

REACTANCE TUBE CIRCUIT ARRANGEMENT

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Fig. 1.

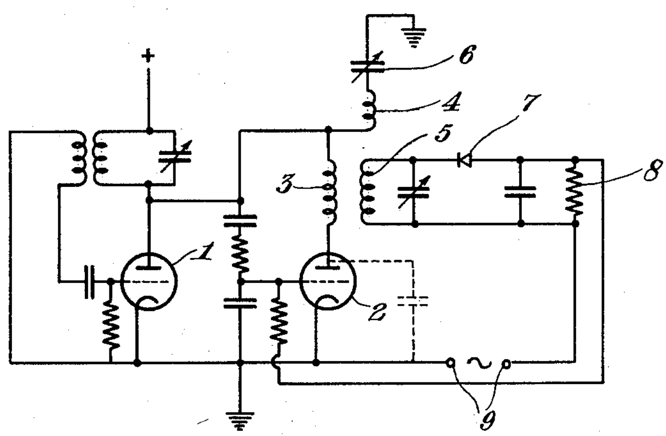
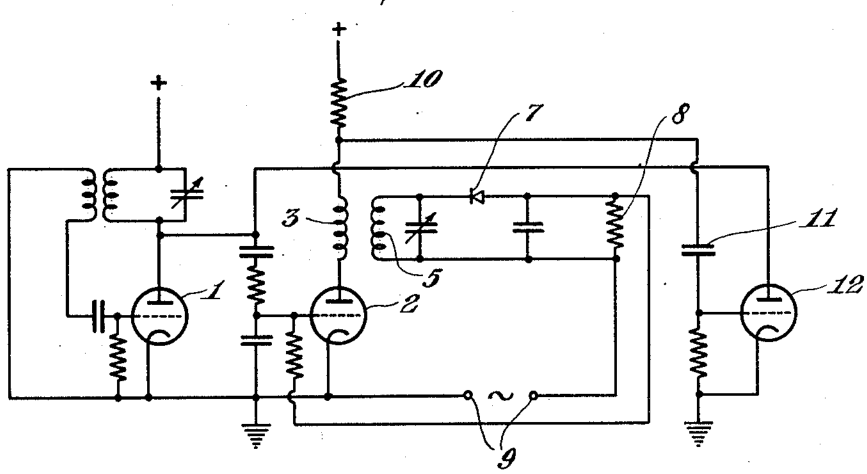


Fig. 2.



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REACTANCE TUBE CIRCUIT ARRANGEMENT

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8 Claims. (Cl. 332—18)

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It is sometimes desired to cause an admittance, generally that of a coil or a condenser, to vary periodically in value with a periodical control or modulating voltage and to ensure that this modulation takes place as linearly as possible.

The invention provides simple means therefor.

The starting-point is in this case the so-called reactance tube by which is meant a tube which is generally utilized in combination with a tuned system and which is controlled in such manner that it behaves with respect to the system as a more or less pure inductance or capacity.

According to the invention, the modulating control voltage is impressed upon such a reactance tube so as to have a controlling effect and, after demodulation, part of the current which flows in this tube and which is modulated in amplitude by the control voltage is fed-back in counterphase to the tube.

The invention is particularly suitable for being applied inter alia to transmitters with frequency modulation. Degenerative coupling of the modulation has previously been suggested for such transmitters but up to the present it has involved the drawback that the signal modulated in frequency had to be detected for this purpose. With the degenerative coupling the almost unavoidable distortion due to this frequency-detection is obtained in the transmitter.

Besides, it is frequently necessary to avoid the production of parasitic oscillations by the use of complicated networks.

Both inconveniences are eliminated by the invention.

The detection of the amplitude-modulated currents in the reactance tube may take place without any distortion and the circuit arrangement is simplified to such an extent that parasitic oscillations are not to be feared.

A further explanation of the invention follows with reference to two practical examples, both applied to a transmitter with frequency modulation, which are represented in Figs. 1 and 2 respectively of the accompanying drawing. Similar or equivalent parts are denoted in both figures by the same reference numerals.

In Fig. 1, 1 denotes a generator tube which may be connected arbitrarily. In parallel with the tuning circuit of the tube is connected a reactance tube 2 whose wiring diagram and operation are well-known and are therefore not described in detail. A new addition is, however, the coil 3 connected to the anode of the tube 2; this coil is traversed by the anode current of the tube 2 but has so slight an impedance that it

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does not have a noticeable influence on the operation of the reactance tube as such.

By means of a coil 5 the coil 3 is coupled with a detector circuit which comprises a rectifier 7 of any type desired and a resistance 8. The voltage variations produced in this resistance are impressed in series but in counter-phase with the modulating voltage applied between terminals 9, 9, upon the grid of the tube 2. If there is no modulation, the tube 2 and the coil 3 are traversed by an alternating current whose frequency is equal to that of the generator and whose phase differs by about 90° from that of the voltage across the generator circuit.

Upon modulation this alternating current in 2 and 3 is caused to vary in value so that in the circuit 5, 7, 8 use may be made of an ordinary detector known for amplitude modulation. Across the ends of the resistance 8 there consequently occur the detected modulating voltages, which may be utilized for degenerative coupling.

Since the capacity of the anode of the tube 2 is not entirely negligible with respect to earth, which capacity is indicated in Fig. 1 by dotted lines, the current which passes in consequence thereof through the coil 3 and whose phase may differ from that above referred to and which has in this case a harmful effect on the desired result, should preferably also be taken into account. This influence can, however, be easily neutralized, as is illustrated in Fig. 1, by causing a similar current to pass through a coil 4 which is likewise coupled with the coil 5 and which is connected to earth through the intermediary of a small condenser 6 of the same capacity as the capacity indicated in dotted lines. The senses of coupling of the coils 3 and 4 with the coil 5 are, of course, taken opposite.

Another method of avoiding the same drawback is illustrated in Fig. 2, in which event it is not the reactance tube 2 itself which is connected in parallel with the generator but a second tube 12 connected in cascade with the tube 2. This series-connection is brought about in this case in the ordinary manner with the aid of an anode resistance 10 and a separating condenser 11. The whole of the current in the tube 2 and therefore in the coil 5 is now in the correct phase determined by the voltages applied to the grid of this tube whilst the voltage of the generator circuit, which is out of phase with respect thereto, is no longer applied to the anode of tube 2 but to that of tube 12 where it cannot influence the circuit 5, 7, 8.

With the use of two exactly similar tubes 2 and it is also possible to control the grids of these tubes in parallel.

I claim:

1. A circuit arrangement for linearly varying an admittance by means of a periodic control voltage, comprising a reactance tube having an anode, a control grid and a cathode, means to apply said control voltage to the control grid of said tube to modulate the current flowing through said tube, means to derive a potential proportional to the amplitude variation of the modulated current, and means to apply said potential to said control grid in opposition to said control voltage thereby to linearize the relationship between variations in the amplitude of said control voltage and said admittance variations.

2. A circuit arrangement for linearly varying an admittance by means of a periodic control voltage, comprising a reactance tube having an anode, a control grid and a cathode, means to apply said control voltage to the control grid of said tube to modulate the current flowing through said tube, means to derive a potential proportional to the amplitude variations of the modulated current, means to apply said potential to said control grid in opposition to said control voltage, a capacitive element having a capacity substantially equal to the anode-cathode capacity of said tube, and means to pass a current through said capacitive element to neutralize the leakage of the anode-cathode capacity of said tube.

3. A circuit arrangement for linearly varying an admittance by means of a periodic control voltage, comprising a reactance tube having an anode, a control grid and a cathode, means to apply said control voltage to the control grid of said tube to modulate the current flowing through said tube, means to derive a potential proportional to the amplitude variations of the modulated current, means to apply said potential to said control grid in opposition to said control voltage, a transfer tube having an anode, a control grid and a cathode, and means to couple the anode of said reactance tube to the control grid of said transfer tube to effect current flow through said tube to neutralize the leakage of the anode-cathode capacity of said reactance tube.

4. A circuit arrangement for frequency modulating a carrier wave, comprising an oscillator circuit having an electron discharge tube to generate said carrier wave, a reactance tube having an anode, a control grid and a cathode, means to apply a voltage in phase quadrature with the voltage generated by said oscillator circuit to the control grid of said reactance tube, means to apply modulating potentials between the control grid and cathode of said reactance tube and to modulate the current flowing through said reactance tube, means comprising a rectifier to derive a direct potential proportional to the amplitude variations of the modulated current, means to apply said direct potential in opposition to said modulating potentials, a capacitor having a capacity substantially equal to the anode-cathode capacity of said reactance tube, means to derive a current proportional to said modulating potentials, means to pass said current through said capacitor to neutralize the anode-cathode capacity of said reactance tube, and means to couple the anode of said reactance tube to said oscillator circuit.

5. A circuit arrangement for frequency modulating a carrier wave, comprising an oscillator circuit having an electron discharge tube to generate said carrier wave, a reactance tube having an anode, a control grid and a cathode, a first resistor, a first capacitor, a transformer having a primary winding, a secondary winding and a tertiary winding, said first resistor, said first capacitor and the primary winding of said transformer being connected in series between the control grid and the cathode of said reactance tube, a rectifier coupled to the secondary winding of said transformer, means to apply modulating potentials between the control grid and cathode of said reactance tube, a load resistor coupled to said rectifier to derive a direct potential proportional to the voltage generated by secondary winding, means to apply said direct potential in opposition to said modulating means, a second capacitor having a capacity substantially equal to the anode-cathode capacity of said reactance tube, means to connect one end of said tertiary winding to the end of said primary winding remote from said anode, means to connect said second capacitor between the remaining end of said tertiary winding and the cathode of said reactance tube, means to couple said tertiary winding inductively to said primary winding to induce a current in said tertiary winding to neutralize the anode-cathode capacity of said reactance tube, and means to couple said reactance tube to said oscillator circuit.

6. A circuit arrangement for frequency modulating a carrier wave, comprising an oscillator circuit having an electron discharge tube to generate said carrier wave, a reactance tube having an anode, a control grid and a cathode, means to couple the control grid of said reactance tube to said oscillator circuit to apply a voltage to said control grid in phase quadrature to the voltage generated in said oscillator circuit, means to apply modulating potentials between the control grid and cathode of said reactance tube and to modulate the current flowing through said reactance tube, means comprising a rectifier to derive a direct potential proportional to the amplitude variations of the modulated current, means to apply said direct potential in opposition to said modulating potentials, a transfer tube having an anode, a control grid and a cathode, means to couple the control grid of said transfer tube to the anode of said reactance tube to neutralize the anode-cathode capacity of said reactance tube, and means to couple the anode of said transfer tube to said oscillator circuit.

7. A circuit arrangement for frequency modulating a carrier wave, comprising an oscillator circuit having an electron discharge tube to generate said carrier wave, a reactance tube having an anode, a control grid and a cathode, a first resistor, a first capacitor, said first resistor and said first capacitor being connected in series to couple the control grid of said reactance tube to said oscillator circuit to apply a voltage to said control grid in phase quadrature to the voltage generated in said oscillator circuit, a transformer having a primary winding and a secondary winding, a second resistor, means to connect said second resistor and the primary winding of said transformer in series between the anode and cathode of said reactance tube, means to apply modulating potentials between the control grid and cathode of said reactance tube, a rectifier coupled to the secondary winding of said transformer, a load resistor coupled to said rectifier to derive a direct potential proportional to the voltage generated by said secondary winding, means to apply said direct potential in opposition to said modulating potentials, a transfer tube

having an anode, a control grid and a cathode, means to couple said second resistor to the control grid of said transfer tube to neutralize the anode-cathode capacity of said reactance tube, and means to couple the anode of said transfer tube to said oscillator circuit.

8. A circuit arrangement for frequency modulating a carrier wave comprising, means including an electron discharge tube for generating said carrier wave, a reactance tube having an anode, a control grid and a cathode, means to apply a voltage in phase quadrature with the voltage generated by said carrier wave generator to the control grid of said reactance tube, means to apply modulating potentials to the control grid of said reactance tube to modulate the current flowing through said reactance tube, means comprising a rectifier coupled to the anode of said reactance tube to derive a direct potential proportional to the amplitude of said modulating potentials, and means to apply said direct potential to the control grid of said reactance tube in phase opposition to said modulating potentials thereby to linearize the relationship between frequency deviations of said carrier wave and variations in said modulating potential.

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