

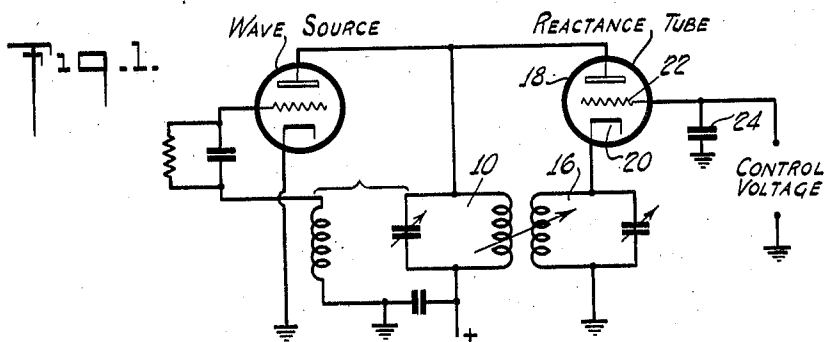
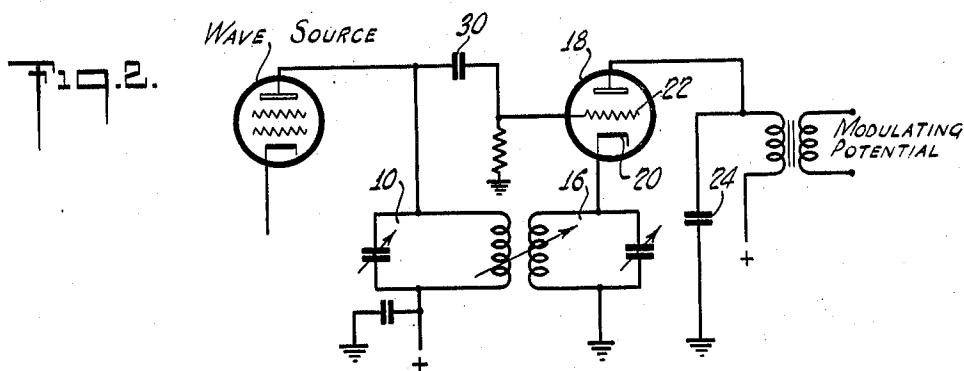
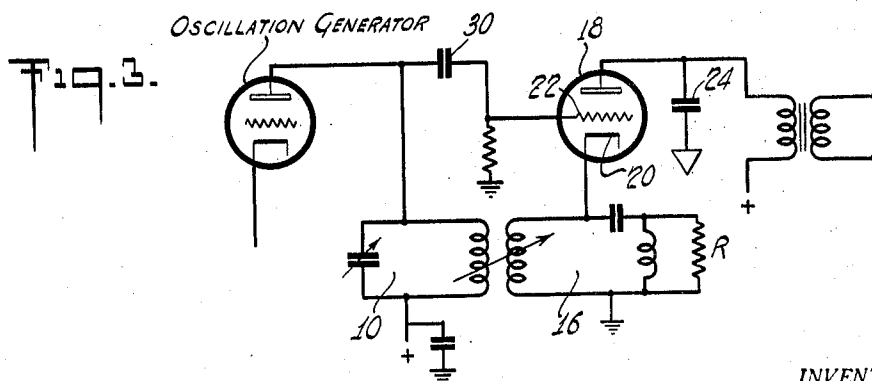
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2,351,368

REACTANCE TUBE

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2,351,368

REACTANCE TUBE

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7 Claims. (Cl. 250—40)

The object of this invention is to provide a reactance tube capable of producing relatively large values of susceptance.

In the prior art of reactance tubes it has often been the case that in the process of producing a phase shift most of the radio frequency voltage applied to the phase shifting network of the reactance tube has been lost in the phase splitting circuit, so that the output of the reactance tube is relatively small. In accordance with the present invention, coupling means are employed between the reactance tube circuits and the terminals between which the reactance effect is to be produced, of such a nature as to provide the required phase shift without any loss of magnitudes.

In Fig. 1 the reactance tube is arranged to provide a variable natural frequency for the oscillator tank circuit 10. For this purpose, the oscillator tank circuit 10 is coupled to the tuned cathode circuit 16 of the reactance tube 18, thereby inducing a relatively large voltage of quadrature phase upon the cathode 20 of the reactance tube. The grid 22 is held at radio frequency by ground potential by bypass condenser 24, and hence the plate current of the reactance tube, feeding back into the oscillator tank circuit 10, provides the effect of susceptance across the oscillator tank. The sign of this susceptance is determined by the polarity of said coupling between 10 and 16 and its magnitude is proportional to the transconductance of the reactance tube 18. Modulating voltage may be impressed upon the reactance tube grid to control its transconductance and thereby to control the frequency of the oscillator.

In Fig. 2 the grid and plate connections of the reactance tube are interchanged so that the full tank voltage upshifted in phase is impressed upon the grid through condenser 30, while the plate circuit of the reactance tube is coupled back to the oscillator tank since the cathode circuit 16 is part of the plate circuit. In this case the phase shift takes place in the coupling between the plate circuit of the reactance tube and the voltage induced in the oscillator tank 10. Modulating potentials could be applied to the grid of the reactance tube as before, but may also be applied to the plate circuit as shown in the drawing.

Figs. 1 and 2 are particularly suitable for providing variable reactance in circuits working at substantially constant frequency or over a narrow range of frequencies, such as in the case

of phase modulation or narrow band frequency modulation. In order to adapt these circuits to a wider range of frequencies, however, I have shown in Fig. 3 a modification of the cathode circuit of reactance tube, which makes the impedance of the cathode circuit substantially a pure resistance over a relatively wide range of frequencies. In Fig. 3 the cathode and ground are connected to the input terminals of a filter circuit terminated by its characteristic resistance represented by R. Only one section of filter is shown, but more sections may be provided with somewhat improved results. The filter is so chosen that a shunt inductance is present across the input terminals. Thus, the current through this shunt inductance is in quadrature with the cathode current and, therefore feeds back to the tank circuit a voltage which has a reactive effect upon the tank circuit. Filter arrangements for providing a pure resistive impedance over a wide range of frequencies in the output circuit of a tube are shown in my Patent No. 1,925,340.

It will be realized that two reactance tubes may be employed to provide reactances of opposite sign but of magnitudes which are equal in the absence of modulating voltages. Then if modulating voltages are applied differentially to the two tubes, the net reactive effect will become positive or negative in accordance with the polarity of the modulating voltage.

I claim:

1. In a system for providing, within a selected range of frequencies, a variable reactance between a pair of terminals, one of which terminals is at unvarying potential, a coil connected between said terminals, a reactance tube having a plurality of cold electrodes and a cathode, an inductance connected between said cathode and ground and further elements for producing within said range of frequencies, a substantially pure resistive impedance between said cathode and ground, mutual inductance between said coil and said inductance, a connection between a point on said coil other than the point connected to the terminal of unvarying potential and a cold electrode of said reactance tube, a low impedance radio frequency connection between another cold electrode and ground, and means for impressing control voltage of relatively low frequency upon one of said cold electrodes to control the transconductance of said tube and thereby the effective reactance between said terminals.

2. A system as recited in claim 1 wherein said

further elements include a filter circuit connected with said first mentioned inductance.

3. In a system for providing, within a selected range of frequencies, a variable reactance between a pair of terminals, a coil connected between said terminals, a reactance tube having an anode, a control electrode and a cathode, an inductance connected between said cathode and ground and further elements for producing within said range of frequencies a substantially pure resistive impedance between cathode and ground, mutual inductance between said coil and inductance, a connection between said coil and the anode of said reactance tube, a low impedance radio frequency connection between the control electrode of said tube and ground, and means for modulating the potential on an electrode of said tube in accordance with signals to thereby control the transconductance of said tube and the effective reactance between said terminals.

4. In a system for providing, within a selected range of frequencies, a variable reactance between a pair of terminals, a coil connected between said terminals, a reactance tube having an anode, a cathode and a control grid, an inductance connected between said cathode and ground and further elements for producing within said range of frequencies a substantially pure resistive impedance between cathode and ground, mutual inductance between said coil and said inductance, a connection between said coil and the control grid of said reactance tube, a low impedance radio frequency connection between the anode of said tube and ground, and means for modulating the gain of said tube in accordance with signals to thereby control the transconductance of said tube and the effective reactance between said terminals.

5. In a timing modulation system, a source of oscillations of carrier wave frequency the timing of which is to be modulated, said source including an inductance, a reactance tube having an electron receiving electrode, an electron flow control electrode and a cathode, a second inductance connected between said cathode and ground and further elements associated with said second inductance for producing for frequencies of the order of said carrier wave frequency a substantially pure resistive impedance between said cathode and ground, there being mutual inductance between said first and second inductances, a coupling between a point on said first named inductance and one of the other two electrodes of said tube, a coupling between a point on said first inductance other than said first point and ground, a low impedance connection between the other of said two recited electrodes and ground, a source of modulating potentials and connections from said source of modulating potentials to the elec-

trodes of said tube for controlling the transconductance of said tube and thereby the effective reactance in said first inductance in accordance with modulating potentials.

6. In a timing modulation system, a source of oscillations of carrier wave frequency the timing of which is to be modulated, said source including an inductance, a reactance tube having an electron receiving electrode, an electron flow control electrode and a cathode, a second inductance connected between said cathode and a point of low alternating current potential and further elements associated with said second inductance for producing for frequencies of the order of said carrier wave frequency a substantially pure resistive impedance between said cathode and said point of low potential, there being mutual inductance between said first and second inductances, a coupling between a point on said first named inductance and the electron flow control electrode of said tube, a coupling between a point on said first inductance other than said first point and said point of low potential, a low impedance connection between said electron receiving electrode and said point of low potential, a source of modulating potentials and connections from said source of modulating potentials to the electron receiving electrode of said tube for controlling the transconductance of said tube and thereby the effective reactance in said first inductance in accordance with modulating potentials.

7. In a timing modulation system, a source of oscillations of carrier wave frequency the timing of which is to be modulated, said source including an inductance, a reactance tube having an electron receiving electrode, an electron flow control electrode and a cathode, a second inductance connected between said cathode and a point of low alternating current potential and further elements associated with said second inductance for producing for frequencies of the order of said carrier wave frequency a substantially pure resistive impedance between said cathode and said point of low potential, there being mutual inductance between said first and second inductances, a coupling between a point on said first named inductance and the electron receiving electrode of said tube, a coupling between a point on said first inductance other than said first point and said point of low potential, a low impedance connection between the electron flow control electrode and ground, a source of modulating potentials and connections from said source of modulating potentials to the electron flow control electrode of said tube for controlling the transconductance of said tube and thereby the effective reactance in said first inductance in accordance with modulating potentials.

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