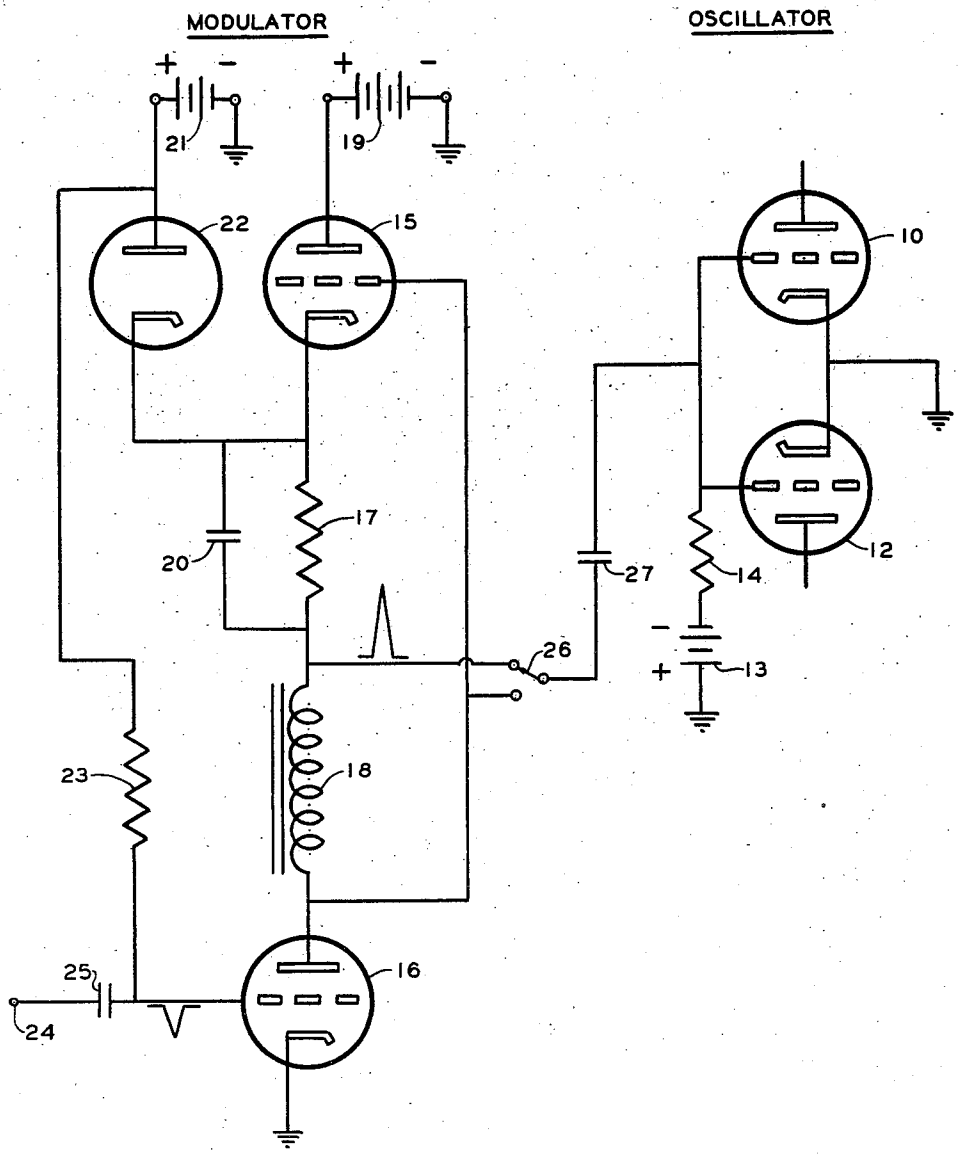
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MODULATOR CIRCUIT

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MODULATOR CIRCUIT

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5 Claims. (Cl. 250—27)

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1

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to electron tube modulating networks, particularly the application of such networks for pulse modulating the transmitter of pulse-echo object detection equipment.

The tubes of such transmitters are usually maintained at cutoff by a high negative bias impressed upon the grids, or insufficient potential on the plates. Sharp positive pulses of high peak power, developed in a modulator, are impressed on said grids to overcome said bias, or on said plates to raise their potential, so that the transmitter oscillates for the duration of said pulses. Such oscillating periods are of relatively short duration separated by intervals of considerably longer duration.

Reference is made to the application of James R. Moore, Serial No. 495,718, filed on even date herewith, directed to a modulator which consumes a substantial amount of power only while the transmitter is being pulsed. This is accomplished by using in the output circuit of the modulator tube an electronic impedance which is varied simultaneously with, and in opposite sense as, the impedance of the modulator tube.

It is an object of the present invention, generally, to improve the invention disclosed in the Moore application above referred to. This is done by providing more rapid and effective means for oppositely varying the conductivities of the modulator impedances so that sharper pulses can be generated.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the accompanying claims.

Referring to the drawing, which shows a schematic circuit of my invention, tubes 10 and 12 are part of a conventional transmitter oscillator, the usual plate potential sources and tuning and coupling elements being omitted. Said tubes are normally blocked by means of a negative potential, impressed upon the grids thereof, from a potential source 13 through a high resistance 14. Said tubes are adapted to be intermittently unblocked by means of sharp positive pulses of voltage impressed upon the grids in such direction as to overcome said negative bias, so that the oscillator functions for the duration of said pulses.

The pulses are derived from the output circuit

2

of a modulator network comprising two tubes 15 and 16 having their space current paths connected in series with a resistor 17, a choke 18, and a source of high potential B voltage 19. A condenser 20 shunts resistor 17. Tube 16 is also connected to a second source of B voltage 21 in series with a diode 22, resistor 17, and choke 18. Source 21 is of considerably lower voltage than source 19.

The grid of tube 16 is also biased positively from source 21 through a high resistance 23. A separate biasing source may be used if desired. Terminal 24 is adapted to be connected to a source of intermittently generated negative-going pulses of short duration spaced at intervals of considerably longer duration. These pulses are impressed on the grid of tube 16 through a blocking condenser 25, of low impedance to the pulse energy.

Either end of choke 18 can be coupled to the grids of oscillator tubes 10 and 12 through a two position switch 26 and a blocking condenser 27, of low impedance to the pulse energy.

The above described circuit operates as follows: Since there is a positive grid bias impressed on tube 16, said tube is highly conducting and a large current flows from source 21, through diode 22, resistor 17, choke 18, the anode-cathode path of tube 16, and then back to the source through ground. This current builds up an intense magnetic field in choke 18.

The voltage drop across resistor 17 and choke 18 biases the grid of tube 15 negatively with respect to its cathode, so that said tube operates at or below plate current cutoff and no current can flow therethrough from source 19. Under these conditions, tube 15 constitutes, in effect, a load of substantially infinite impedance in the anode circuit of tube 16 so that no power is dissipated by source 19.

The grid of tube 16 is intermittently rendered negative by the pulses impressed thereon from terminal 24. Each pulse blocks tube 16 so that the current through resistor 17 and choke 18 is reduced to zero. As a result, the blocking bias on the grid of tube 15 is removed and in addition, a strong positive voltage, generated by the sudden collapse of the field in the choke, is applied to said grid, whereby the impedance of said tube is suddenly reduced to an extremely low value. The decay of the negative biasing voltage is determined by the time constant of resistor 17 and condenser 20.

This causes the potential at the cathode of tube 15 to rise substantially to the potential of the anode of said tube, and a sudden surge of

current takes place from source 19, through tube 15, resistor 17, switch 26, blocking condenser 27, of low impedance to the pulse voltage, and resistor 14 to ground. The direction of this current is such as to bias the grids of the oscillator tubes highly positive in opposition to the negative bias of source 13. Diode 22 prevents dissipation of this voltage to ground. As a result, the oscillator grids are rendered sufficiently positive to cause the oscillator to generate high frequency oscillations for the duration of each pulse. The cycle of operations above described are repeated for each negative pulse applied to the grid of tube 16. If plate modulation is used, then the output of the modulator will obviously be applied to the plates of the oscillator.

Switch 26 is connected to the upper position, as shown, because the load presented by the oscillator is assumed to be of low impedance. Under such condition, connection to the lower end of the choke would tend to shunt out the high positive potential developed by the collapsing field in the choke.

In the case where the impedance presented by the oscillator is high, switch 26 may be moved to the lower position, so that the high positive voltage developed in the choke is also impressed on the oscillator grids so as to add to the effect obtained from tube 15.

It will be seen that relatively little power is dissipated by the modulator during the intervals between pulses, even though tube 16 is conducting. The combined resistance of resistor 17 and choke 18 is of the order of a few hundred ohms and the voltage of source 19 is small compared to the voltage of source 21. Hence the power dissipated between pulse intervals is relatively low compared to the peak power developed in the circuit.

While there has been described what is at present considered a preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims, to cover all such changes and modifications as fall within the true spirit and scope of the invention.

I claim:

1. A network comprising a first grid-controlled electron tube and means in its grid circuit to vary the impedance thereof, a second grid-controlled electron tube, a first circuit including a source of potential, the anode-cathode path of said second grid-controlled electron tube, a choke, and the anode-cathode path of said first tube, all connected in a closed series circuit in the order named, a second circuit exclusive of said second electron tube and including a source of potential, said choke, and said anode-cathode path of said first tube, all in a closed series circuit in the order named, a connection from the anode of said first tube to the grid of said second tube, and an output circuit coupled to a terminal of said choke.

2. A network comprising a first grid-controlled electron tube and means in its grid circuit to vary the impedance thereof, a second grid-controlled electron tube, a first circuit including a source of potential, the anode-cathode path of said second grid-controlled electron tube, a resistor, a choke, and the anode-cathode path of said first tube, all connected in a closed series circuit in the order named, a second circuit including a second source of potential, a diode, said resistor, said choke, and said anode-cathode path of said first tube, all in a closed series circuit in the order named, a connection from the anode of said first tube to the grid of said second tube, an output circuit, and means to couple the latter to either terminal of said choke.

3. An electron tube network comprising a diode, first and second electron tubes each having at least an anode, cathode and grid, a resistor having one end connected to the cathodes of said diode and said first tube and the other end connected to one end of a choke, the other end of said choke being connected to the anode of said second tube and the grid of said first tube, means to impress steady positive potentials upon the anodes of said diode and said first tube, with reference to the cathode of said second tube, said second tube being normally conducting whereby a current flows through said diode, said resistor, said choke and said second tube, and whereby the resulting voltage drop across said resistor biases the grid of said first tube negative, means to vary the conductivity said second tube, an output circuit and means to couple said output circuit between the cathode of said first tube and the anode of said second tube.

4. An electronic network comprising a diode, first and second electron tubes each having at least an anode, cathode and grid, a resistor having one end connected to the cathodes of said diode and said first electron tube and the other end connected to one end of a choke, the other end of said choke being connected to the anode of said second tube and the grid of said first tube, means to impress steady positive potentials upon the anodes of said diode and said first tube, with reference to the cathode of said second tube said second tube being normally conducting whereby a current flows through said diode, said resistor, said choke and said second tube, and whereby the resulting voltage drop across said resistor maintains the grid of said first tube sufficiently negative to render it non-conducting, means to render said second tube momentarily non-conducting, whereby said voltage drop is decreased and the current through said choke is interrupted, means responsive to said interruption to render said first tube highly conducting so that the positive potential of its cathode is increased, and a high impedance load circuit coupled to the junction of said choke and the anode of said second tube.

5. An electron tube network comprising a diode, first and second electron tubes each having at least an anode, a cathode and grid, a resistor having one end connected to the cathodes of said diode and said first electron tube and the other end connected to one end of a choke, the other end of said choke being connected to the anode of said second electron tube and the grid of said first tube, means to impress steady positive potentials upon the anodes of said diode and said first electron tube with reference to the cathode of said second tube, said second tube being normally conducting whereby a current flows through said diode, said resistor, said choke, and said second tube, and whereby the resulting voltage drop across said resistor maintains the grid of said first tube sufficiently negative to render it non-conducting, means to render said second tube momentarily non-conducting, whereby said voltage drop is decreased and the current through said choke is interrupted, means responsive to said interruption to render said first tube highly conducting so that the positive potential

of its cathode is increased, and a low impedance load circuit coupled to the junction of said choke and said resistor.

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