

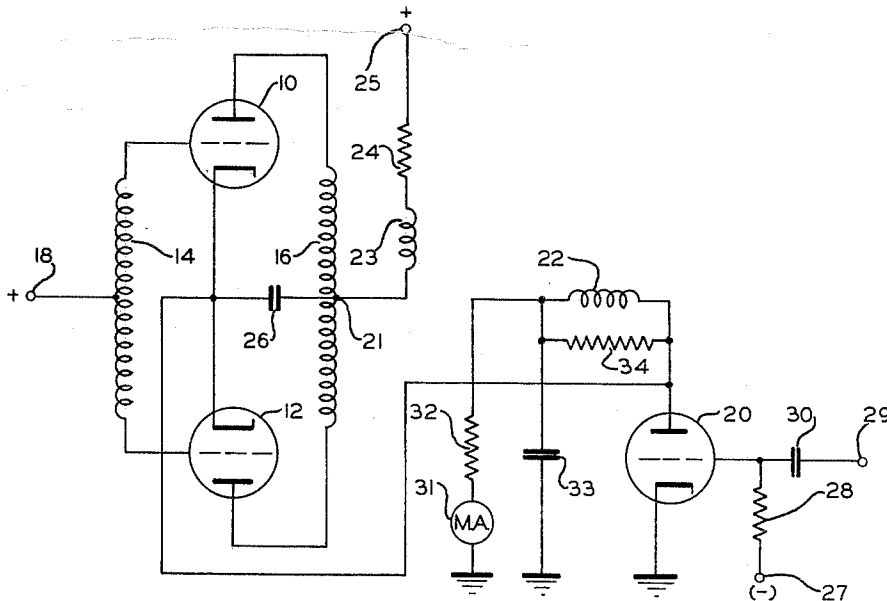
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TRIGGERED PUSH-PULL OSCILLATOR

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TRIGGERED PUSH-PULL OSCILLATOR

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This invention relates to oscillators and more particularly to improving the stability and incisiveness of operation of push-pull type oscillators.

Heretofore, push-pull oscillators as used in various types of electronic apparatus have had the difficulty of starting oscillations sluggishly when triggered into operation by a pulse of voltage. Since these oscillators are used in applications where incisive beginning of oscillations and decisive stopping of oscillations are important, the above-mentioned difficulty is undesirable.

It is a primary object of this invention to overcome this difficulty.

It is an object of this invention to provide a push-pull type oscillator which can be triggered with a pulse of voltage.

Another object is to provide a push-pull type oscillator which begins operating incisively and stably.

A further object is to provide a push-pull type oscillator which combines proper bias voltage with a pulse voltage to make it start and stop oscillating quickly, stably, and incisively.

These and other objects will become apparent when taken in conjunction with the drawing which is a schematic drawing of one form which the invention may take.

In the drawing are revealed two electron tubes 10 and 12 with their cathodes connected together, their control grids connected to opposite ends of coil 14 and their plates connected to opposite ends of coil 16. Coil 14 and 16 represent schematically the inductive portions of resonant circuits of which the capacitive portions are not shown. In high frequency apparatus coil 14 and coil 16 may take the form of transmission line resonant circuits. The midpoint of coil 14 is connected to a source of positive voltage at terminal 18 thus putting the grids of tubes 10 and 12 at a positive potential. The cathodes of tubes 10 and 12 are connected directly to the plate of electron tube 20 which is the modulator tube. Tube 20 is normally biased to cut-off since its cathode is grounded directly and its control grid is connected to a negative voltage at terminal 27 through resistor 28. The control grid of tube 20 is also coupled to an input terminal 29 through capacitor 30. The junction point of the cathodes of tubes 10 and 12 and the plate of tube 20 is connected to one end of coil 22 which is shunted by resistor 34. The other end of coil 22 is tied to one end of resistor 32 whose other end is connected to a terminal of meter 31. The other terminal of meter 31 is grounded. The series con-

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nection consisting of resistor 32 and meter 31 is shunted by capacitor 33. The cathodes of tubes 10 and 12 are further connected to a storage capacitor 26 whose other terminal is tied to the midpoint of coil 16 at point 21. Point 21 is coupled to a source of high positive voltage at terminal 25 through a high frequency choke coil 23 and an isolating resistor 24 connected in series.

In the operation of this embodiment as revealed in the drawing, electron tube 20 is a modulator tube which is biased to cut-off as explained above. During the steady state condition of this embodiment capacitor 26 becomes charged. When the oscillator is not being pulsed tubes 10 and 12 are conducting slightly, enough to place a rather high positive voltage across resistor 32. There is no appreciable voltage drop across coil 22 because of its low resistance to a D. C. voltage.

When a large positive pulse is applied to the control grid of tube 20 it starts conducting. The flow of plate current through tube 20 causes the voltage at the plate and therefore at the cathodes of tubes 10 and 12 to drop. This voltage drop is large enough to make the cathodes of tubes 10 and 12 somewhat negative with respect to their control grids, and capacitor 26, which is a large storage condenser, discharges causing large plate currents to flow through tubes 10 and 12. The slight unbalance necessary to initiate push-pull oscillation in tubes 10 and 12 and their associated circuits is thereby accentuated, so the high frequency oscillations build up quickly and sharply.

Previous practice would have been to ground the center tap of coil 14 at terminal 18 with no positive bias on the grids of tubes 10 and 12. Then, although the cathode voltages of both tubes 10 and 12 dropped due to the modulation they were still quite positive with respect to their grids, the plate currents through tubes 10 and 12 consequently were small and the starting of oscillations was sluggish.

Connecting a positive grid to terminal 18, instead of grounding that terminal, has other advantages. Since the oscillations at the desired frequency build up quickly, trouble from unwanted oscillations is minimized and less damping is required to suppress them. Less damping for parasitic oscillations means less power loss in the circuit at the desired frequency and consequently increases the power output accordingly. Also, since the modulator tube 20 and the snuffing circuit including coil 22 are operated at higher voltages than before, the snuffing action is increased in effectiveness.

The snuffing circuit in this embodiment works

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as follows. A positive pulse of voltage delivered to terminal 29 overcomes the bias on tube 20 causing it to start conducting. The flow of current through coil 22 causes a large storage of energy. When the pulse ends and tube 20 cuts off, the plate voltage jumps up, the upward jump being considerably aided by the action of coil 22. The energy stored in coil 22 will be dissipated by shunting resistor 34 while the cathodes of tubes 10 and 12 are still positive enough with respect to their respective grids to keep tubes 10 and 12 non-conducting.

The push-pull oscillator circuit including tubes 10 and 12 does not retrigger into oscillation until tube 20 is again cut on by a positive pulse of voltage.

This invention is to be limited only by the appended claims.

What is claimed is:

1. Electronic apparatus for producing sharply defined pulses of high frequency oscillation comprising, a push-pull oscillator circuit including first and second electron tubes each having at least a cathode, an anode, and a control grid, said control grids being symmetrically connected to a first electrically resonant circuit, said anodes being connected to a second electrically resonant circuit, a source of positive voltage connected to said control grids, a source of space current connected to said anodes, a common resistor in the grid-cathode circuits of said first and second electron tubes, the voltage developed across said resistor by the space current drawn through said first and second electron tubes maintaining said oscillator in a normally non-oscillating condition, a third electron tube having at least a cathode, an anode, and a control grid, said anode of said third electron tube being coupled directly to the cathodes of said first and second electron tubes, a source of negative voltage connected to said control grid of said third electron tube maintaining said third electron tube in a normally non-conducting condition, an input circuit adapted to apply positive voltage pulses to said control grid of said third electron tube, said input voltage pulses causing said third electron tube to conduct for sharply defined periods of time, said periodic conduction of said third electron tube lowering the voltage at said cathodes of said first and second electron tubes and causing said oscillator to oscillate during said periods of time.

2. Apparatus as in claim 1 wherein the voltage, to which said cathodes of said first and second electron tubes is lowered, is positive and of a magnitude substantially equal to that of the source of positive voltage connected to the control grids of said first and second tubes, whereby the magnitude of the grid to cathode voltage of said first and second tubes is substantially equal to zero during the conduction of said third electron tube.

3. Electronic apparatus for producing sharply defined pulses of high frequency oscillations comprising, a push-pull oscillator circuit includ-

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ing two electron tubes each having at least an anode, a control grid and a cathode, a source of positive grid bias voltage for said tubes, a pulse modulator circuit adapted to provide a negative voltage pulse output, and means coupling said modulator output to the grid-cathode circuit of said oscillator for reducing the potential at said cathodes, said bias voltage maintaining said oscillator in a normally non-oscillating condition, said modulator pulse output causing operation of said oscillator during sharply defined time periods.

4. Apparatus for producing sharply defined pulses of high frequency oscillations comprising, a push-pull oscillator including first and second electron tubes each having at least an anode, a cathode, and a control grid, said cathodes being connected together, said control grids and said anodes being respectively connected to first and second resonant circuits, a first source of positive voltage connected to said control grids, a second source of positive voltage connected to said anodes, a common cathode resistor for said tubes connected between said cathodes and a point of reference potential, the voltage developed across said resistor by space current in said first and second tubes maintaining said oscillator in a normally non-oscillating condition, means for applying a negative pulse directly to the cathodes of said first and second tubes to reduce the voltage of said cathodes to a positive value substantially equal to that of said first source of positive voltage whereby the grid to cathode voltage of said first and second tubes is substantially equal to zero during the application of said pulse.

5. Apparatus for producing sharply defined pulses of high frequency oscillations comprising, a push-pull oscillator circuit including a pair of electron tubes each having at least a cathode, a grid and an anode, the cathodes of said tubes being connected together, a source of positive bias voltage connected to the grids of said tubes, a source of positive voltage connected to the anodes of said tubes, an indicator and a resistor connected in series between said cathodes and a point of reference potential, said bias voltage normally maintaining said oscillator in a non-oscillating condition, means for applying a negative pulse to the grid-cathode circuit of said oscillator to reduce the potential of said cathodes to a positive value substantially equal to that of said bias voltage, whereby said oscillator goes into oscillation during the application of said pulse.

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