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VACUUM TUBE CIRCUITS

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Fig. 1

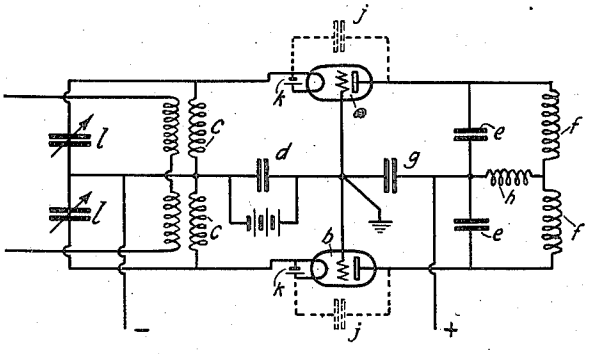
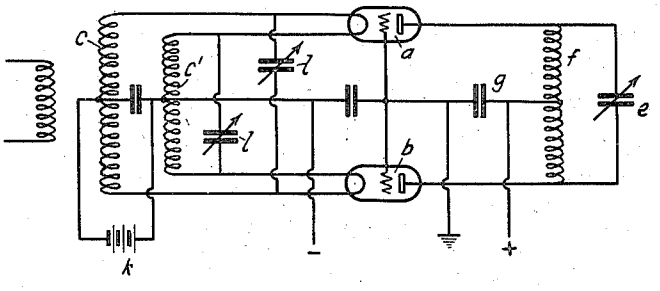


Fig. 2



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VACUUM TUBE CIRCUITS

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16 Claims. (Cl. 179—171)

This invention relates to vacuum tube circuits, and more particularly to push-pull circuits employing three electrode tubes for operation at very high frequencies.

Among vacuum tube amplifier and transmitter systems employed for short wave work those operating on the push-pull principle have proven particularly successful. Heretofore in separately controlled transmitter or receiving set amplifier circuits reaction produced by the anode circuit upon the input or control electrode circuit by reason of the anode to control electrode capacitance has been prevented by the use of neutralizing condensers. In order to obtain waves of as short length as possible, compensating condensers constitute a difficulty inasmuch as they tend to increase the minimum capacities (in the tubes, coils, etc.) which are present. They also constitute a difficulty when looked at from the viewpoint of manipulation and operation of the equipment inasmuch as they must be perfectly balanced.

According to the disclosure of the present invention, both these demerits are eliminated by a phase-opposition scheme in which, also without compensating condensers, reaction by the plate circuit upon the grid circuit is absent, and in which therefore the production of extra-short waves is not made more difficult by an unnecessary increase of the minimum capacities, while also operation of the apparatus becomes far simpler both in transmitters and receivers.

Figures 1 and 2 illustrate two simplified push-pull circuit arrangements in which are incorporated the novel features of my invention.

The basic idea of the invention is illustrated by way of example in Figure 1. The grids *a* and *b* of the two transmitter valves, or electron discharge tubes are directly connected with each other, and, if desired, they are grounded. The control potential is supplied by way of coil C to the ground-insulated filaments. Tuning condensers *l* may be connected in parallel with the input coils *c*. The middle point of the coil is united in well-known manner with the ground-connection and grid point. Between the plates, in well known manner, there is connected the oscillation circuit comprising the two series-connected condensers *e* and the coil *f—f*.

The plate direct current potential is united with its negative pole with the middle of the coil *c*, with its positive pole with the joint point of the condensers *e*. The plate current flows by way of the common point of the condensers *e* and by way of a choke coil *h* and coils *f* to the plates.

Reaction through the plate-grid capacitance is unable to arise in this scheme. The only reaction which might be imaginable would be by way of the capacity between plate and filament, to be more precise, only through that part of this capacity which is not formed by the path plate-grid filament. The capacitance producing reaction, as will be seen, is far lower in this circuit arrangement than in those heretofore known. The stray capacitance plate-filament is indicated by dash lines in the drawing and is denoted by *j*. Figure 1 further includes separate filament sources *k* for each of the filaments. This arrangement may be modified so that a common heating source is used for the tube filaments. An example of this is illustrated in Figure 2, in which the input inductance is composed of two similar parallel connected inductances *c* and *c'*. These operate in parallel with respect to the radio frequency, and are tuned by condensers, preferably, parallel connected condensers *l*. At the same time the inductances *c* and *c'* operate in series with respect to the filament heating current, which may be provided from any suitable source *k*. In other respect this circuit may be arranged like that in Figure 1, or in any substantially similar manner.

I claim:

1. The method of reducing the feed back from the output circuit to the input circuit of a push pull vacuum tube amplifier which includes keeping the control electrodes of the tubes at a constant potential, applying the input oscillations to the cathodes of the tubes in push pull, and collecting the output energy from the anodes of the tubes, whereby the control electrodes act as screens between the cathodes and anodes.

2. A push pull vacuum tube circuit comprising a pair of three electrode vacuum tubes, an input circuit coupled to the cathodes of the tubes, an output circuit coupled to the anodes of the tubes, and means including a connection to ground for connecting the control electrodes directly together, whereby the control electrodes act as screens between the cathodes and anodes of the tubes.

3. A push pull vacuum tube circuit comprising a pair of three electrode vacuum tubes, an input circuit coupled to the cathodes of the tubes, an output circuit coupled to the anodes of the tubes, and means connecting the control electrodes directly together and to ground, whereby the control electrodes act as grounded screens between the cathodes and anodes of the tubes.

4. A push pull vacuum tube circuit compris-

ing a pair of three electrode vacuum tubes, a resonant input circuit coupled between the cathodes of the tubes, a resonant output circuit coupled between the anodes of the tubes, and means connecting the control electrodes directly together and to ground to cause them to act as grounded screens between the cathodes and anodes of the tubes.

5. A push-pull vacuum tube circuit comprising a pair of multi-electrode tubes, an input circuit comprising an input inductance composed of two similar parallel connected inductances coupled to the cathodes of the tubes, an output circuit coupled to the anodes of the tubes and means common to both cathode-control electrode circuits for maintaining the control electrodes at a constant potential to cause them to act as screens between the cathodes and anodes of the tubes.

6. A push-pull vacuum tube circuit comprising a pair of three-electrode vacuum tubes, an input circuit coupled to the cathodes of the tubes comprising an input inductance composed of two similar parallel connected inductances and separate tuning condensers shunted across each of said inductances, an output circuit coupled to the anodes of the tubes, and means including a connection to ground for connecting the control electrodes directly together whereby the control electrodes act as screens between the cathodes and anodes of the tubes.

7. A push-pull vacuum tube circuit comprising a pair of three-electrode vacuum tubes, a resonant input circuit comprising an input inductance composed of two similar parallel connected inductances and individual tuning condensers shunted across each of said inductances, a condenser connected across the midpoint of said inductances and a source of current shunted across last named said condenser, a resonant output circuit coupled between the anodes of the tubes, means connecting the control electrodes directly together and means for maintaining said control electrodes at a constant potential to cause them to act as screens between the cathodes and anodes of the tubes.

8. An electron discharge tube relay comprising, a pair of electron discharge tubes each having an electron emission element, an anode electrode, and an auxiliary electrode located between said emission element and said anode electrode, inductors connecting said emission elements together, a circuit for applying short radio frequency waves to be relayed by said tubes to said inductors, a repeater circuit connected between the anode electrodes of said tubes and to the emission elements of said tubes, and means for insuring stable operation of said relay including a circuit connecting said auxiliary electrodes to ground.

9. An electron discharge tube relay comprising, a pair of electron discharge tubes each having an electron emission element, an anode electrode, and an auxiliary electrode located between said anode electrode and said electron emission element, a circuit including inductances for supplying heating energy to the electron emission elements of said tubes, a circuit for impressing radio frequency waves on said inductances, a repeater circuit connected between said anode electrodes and said emission element heating circuit, and means for insuring stable operation of said relay comprising a circuit connecting the auxiliary electrode of each of said tubes to a point at zero alternating current potential.

10. A relay comprising a pair of tubes each having an electron emission element, an anode electrode and an auxiliary electrode located between said anode electrode and said electron emission element, a circuit including inductances for supplying heating energy to the electron emission elements of said tubes, a circuit for impressing oscillating potentials at radio frequency on said inductances, a capacity for connecting points of minimum radio frequency potential on said inductances to said auxiliary electrodes, a repeater circuit including reactances connected between said anode electrodes, reactances for connecting a point on said last named circuit of minimum radio frequency potential to said auxiliary electrodes, and means for insuring stable operation of said relay comprising a circuit connecting the auxiliary electrode of each of said tubes to a point of minimum alternating current potential.

11. In a radio circuit, a pair of electron discharge devices each comprising an evacuated container enclosing electrodes including a filament electrode, inductors connecting the terminals of one of said filament electrodes to the terminals of the other of said filament electrodes, and means for setting up radio frequency potention variations across said inductors whereby said filament electhodes fluctuate in potential in out of phase relation at high frequency and means for energizing said filament electrodes to produce electron emission therefrom.

12. In a radio circuit, a pair of electron discharge devices each comprising an evacuated container enclosing electrodes including a filament electrode, a pair of inductors in parallel connecting the terminals of one filament electrode to the terminals of the other filament electrode, a source of electrical energy connected to said inductors whereby said inductors also supply heating currents to said filament electrodes, and a circuit for setting up radio frequency potential variations across said parallel inductors whereby said filament electrodes fluctuate in potential in out of phase relation at high frequency.

13. In a signalling circuit, a pair of electron discharge tubes each comprising an evacuated container enclosing electrodes including a filament electrode, a pair of inductors in parallel, each of said inductors having one terminal connected to the filament of one of said tubes and the other terminal connected to the filament of the other of said tubes to supply heating current to said filaments, a source of filament heating potential connected with said inductors and means for setting up radio frequency potential variations across said inductors whereby said filament electrodes fluctuate relatively in potential in out of phase relation at high frequency.

14. In a radio circuit, a pair of tubes, each comprising an evacuated container enclosing electrodes including a filament electrode, a pair of inductors in parallel, said inductors connecting the filament electrodes of said tubes in series, means for setting up high potential variations across said inductors whereby said filament electrodes fluctuate in potential in out of phase relation at high frequency, and a source of filament heating current connected to points of minimum radio frequency potential on said inductors.

15. An ultra high frequency amplifier comprising a plurality of thermionic tubes each having a cathode and grid electrode, an inductance adapted to be energized by ultra high frequency

wave energy, a connection between a point on said inductance and one of said cathodes, a connection between a point on said inductance and the other of said cathodes, a connection between a point on said inductance and ground, and a connection between each of the grid electrodes and ground.

16. The method of relaying ultra high frequency oscillations, without altering the wave form of said oscillations during said relaying, by means of a pair of thermionic tubes each having a control grid electrode and a filamentary cathode and a control grid to cathode circuit which includes the steps of, impressing said oscillations in phase to the terminals of the filamentary cathode of one of said tubes, impressing said oscillations in phase to the terminals of the filamentary cathode of the other of said tubes, the phase of the oscillations impressed on said last named filamentary cathode being different than the phase of the oscillations impressed on said first named filamentary cathode, and maintaining the control grids of said tubes at equal substantially ground alternating current potentials.

OTTO BOHM.