

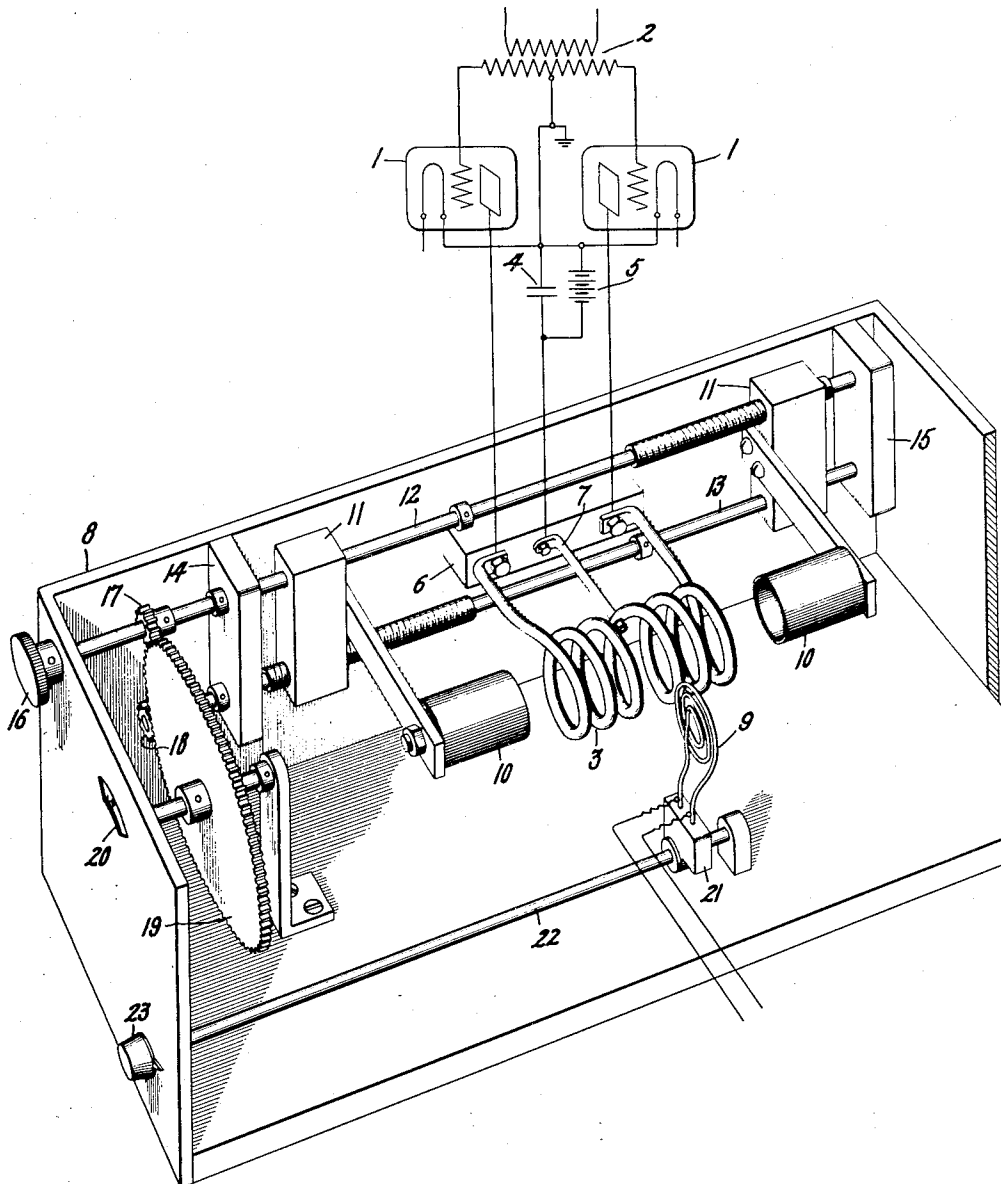
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L. H. LYNN

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HIGH FREQUENCY AMPLIFIER

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Inventor:
Lambert H. Lynn,
by *Harry E. Durham*
His Attorney.

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HIGH FREQUENCY AMPLIFIER

Lambert H. Lynn, Schenectady, N. Y., assignor
to General Electric Company, a corporation of
New York

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My invention relates to high-frequency amplifiers and more particularly to high- and ultra-high frequency push-pull amplifiers.

In ultra-high frequency push-pull amplifiers, it is difficult to obtain proper balanced tuning of the circuits by means of a variable capacitor because of the desirability of maintaining a high inductance-to-capacitance or L/C ratio. It is furthermore desirable when using inductive coupled work circuits, or succeeding amplifiers, to maintain the coupling effect between the output circuit of such an amplifier and the input circuit of a succeeding amplifier or work circuit as highly inductive as possible with the minimum of capacity coupling.

It is an object of my invention to provide an ultra-high frequency push-pull amplifier with an improved tuning arrangement for obtaining a high inductance-to-capacitance or L/C ratio.

It is a further object of my invention to provide ultra-high frequency push-pull amplifiers with an improved tuning arrangement having a low capacity and high inductive coupling between the tuned output circuit and the succeeding circuit.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation together with further objects and advantages thereof, may be understood best by reference to the following description taken in connection with the accompanying drawing which discloses a preferred embodiment of my invention.

Referring to the figure in the drawing, I have disclosed therein a pair of electron discharge devices 1 connected in balanced or push-pull relation. The discharge devices utilized may be of types suitable for high-frequency amplification, but for purposes of simplified illustration are shown in the drawing as three-electrode tubes having their grids connected to the extremities of the secondary of a suitable input coupling device or transformer 2, the midpoint of which is connected to the ground and to the cathodes of the discharge devices. The primary winding of the coupling device 2 may be connected to a suitable source of high frequency oscillations, or to a preceding high-frequency amplifier. The anodes of the discharge devices are connected to the extremities of an inductor 3, the midpoint of which is connected through a capacitor 4 to the cathodes of the discharge devices. A suitable source of potential 5 is connected between the cathodes

and the midpoint of the inductor 3. The capacitor 4 serves to maintain the midpoint of the inductor at radio frequency cathode potential. The circuit as described comprises a balanced or push-pull amplifier.

The inductor 3 is formed of a conductor wound helically and having leads at the extremities thereof so that the inductor is spaced from the supporting block 6 upon which the extremities of the inductor are fastened. The midpoint of the inductor 3 is provided with a conductor 7 which is also supported upon the insulating block 6. The insulating support 6 and the inductor 3 are mounted upon the wall of a suitable cabinet 8. The convolutions of the inductor 3 are separated to a slightly greater degree at the midpoint of the inductor so as to permit a flat or pancake coupling inductor 9 to be inserted between the two halves of the inductor 3. By forming the coupling inductor 9, which is adapted to be connected to a suitable work circuit, in a flat or pancake shape and inserting the inductor into the convolutions of the inductor 3 at the midpoint which is at radio frequency cathode potential, a coupling is provided between the output circuit of the push-pull amplifier and the work circuit which has the maximum inductive and the minimum capacitive coupling effect.

The tuning of the anode circuit of a push-pull amplifier is accomplished by means of a pair of non-magnetic metallic cores 10 arranged coaxially with the inductor 3 at the extremities thereof. These cores are arranged so that they may be introduced simultaneously into the inductor 3 to vary the effective inductance of the anode circuits, thereby tuning the circuits in conjunction with the distributed stray and tube capacities. The cores 10 are mounted upon brackets attached to blocks 11 which move upon the rods 12 and 13. The rods 12 and 13 are arranged parallel to each other and are journaled in a pair of supports 14 and 15. One extremity of the rod 12 is provided with a threaded portion engaging one of the blocks 11. The opposite extremity of the rod 13 is provided with a threaded portion which engages the other block 11. The rod 12 extends through the front of the cabinet 8 and is provided with an actuating knob 16. The shafts 12 and 13 are provided with gears 17 and 18 which mesh with idler gear 19. Actuation of the knob 16 causes simultaneous rotation of the shafts 12 and 13, which causes the blocks 11 to move toward or away from the extremities of the inductor 3 at equal rates. The core members 10 mounted upon the brackets and blocks 11

therefore may be moved simultaneously in and out of the convolutions of the inductor 3. These cores may, of course, be insulated from ground and thus vary the inductance of the coil without materially adding to the capacitance between the coil and ground.

The shaft of the idler gear 19 may be provided with a suitable indicator viewed through the aperture 20 of the cabinet 8.

The pancake coupling member 9 is mounted upon block 21 attached to the shaft 22 which extends through the front of the cabinet 8 and is provided with an actuating knob 23. Actuation of this knob causes the pancake inductor 9 to be moved in and out of the space between the convolutions of the inductor 3, thereby varying the degree of coupling between the output circuit of the push-pull circuit and the work circuit to which the pancake coil 9 is connected.

The core members 10 which are of a non-magnetic metallic material are shown in the form of hollow cylinders, but may be of any other suitable configuration. Various other means for moving the cores in and out of the field of the inductor 3 may of course be employed. The arrangement shown, however, is exemplary of a simple embodiment of such arrangements.

The arrangement shown and described, therefore, provides a tuning arrangement having a high inductance-to-capacitance tuning ratio for the output circuit of the push-pull amplifier, and a high inductive and low capacitive coupling between the output circuit of the amplifier and the work circuit.

While I have shown and described my invention in connection with certain specific embodiments, it will of course be understood that I do not wish to be limited thereto, since it is apparent that the principles herein disclosed are susceptible of numerous other applications, and modifications may be made in the circuit arrangements and in the instrumentalities employed without departing from the spirit and scope of my invention as set forth in the appended claims.

What I claim as new and desire to secure by Letters Patent of the United States, are:

1. In a high-frequency radio apparatus, the combination of a pair of electron discharge devices arranged in balanced relation, said discharge devices each including a cathode and an anode, an inductor connected between said anodes, a connection between said cathodes and an intermediate point on said inductor, a pair of non-magnetic metallic cores arranged to be introduced into the anode ends of said inductors, and means for adjusting the positions of said cores for tuning the anode circuits of said discharge devices.

2. In a high-frequency amplifier, the combination of a pair of electron discharge devices arranged in push-pull relation, said discharge de-

vices each including a cathode and an anode, an inductor connected between said anodes, a connection from the midpoint on said inductor to said cathodes, a pair of non-magnetic metallic cores arranged coaxially with said inductor and at opposite ends thereof, and means for simultaneously introducing said cores into said inductor thereby to tune the anode circuits of said discharge devices.

3. In a high-frequency amplifier, the combination of a pair of electron discharge devices arranged in push-pull relation, said discharge devices each including an anode and a cathode, an inductor connected between said anodes, a connection from said cathodes to the midpoint on said inductor, a non-magnetic metallic core arranged at each end of said inductor coaxially therewith, and means for simultaneously introducing said cores into said inductor thereby to tune said anode circuits of said discharge devices, and a coupling inductor adapted to be inserted between the convolutions of said inductor in the proximity of said midpoint.

4. In a high frequency amplifier, the combination of a pair of electron discharge devices each including an anode and a cathode, said discharge devices being arranged in push-pull relation, a helically wound inductor connected between said anodes, means for maintaining the midpoint of said inductor at radio frequency cathode potential, a non-magnetic metallic member arranged at each end of said inductor coaxially therewith, means for simultaneously introducing said members into the field of said inductor thereby to vary the impedances of said anode circuits, a flat coupling inductor adapted to be introduced between the convolutions of said inductor in the proximity of said midpoint, and means for actuating said coupling inductor.

5. In a high-frequency amplifier, the combination of a pair of electron discharge devices each including an anode and a cathode, said discharge devices being arranged in push-pull relation, a helically wound inductor connected between said anodes, a non-magnetic metallic member arranged at each end of said inductor coaxially therewith, means for simultaneously adjusting the positions of said members to vary the impedances of said anode circuits, means for maintaining the midpoint of said inductor at radio frequency cathode potential, a flat coupling inductor adapted to be connected to a work circuit, and means for introducing said coupling inductor between the convolutions of said first inductor, said means for maintaining said midpoint at radio frequency cathode potential and said latter means cooperating to produce a coupling having maximum inductive and minimum capacitive effect between said anode circuits and said work circuit.

LAMBERT H. LYNN.