March 5, 1940. N. E. LINDENBLAD 2,192,711

ELECTRON DISCHARGE DEVICE CIRCUIT AND MOUNTING ARRANGEMENT

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Fig. 1

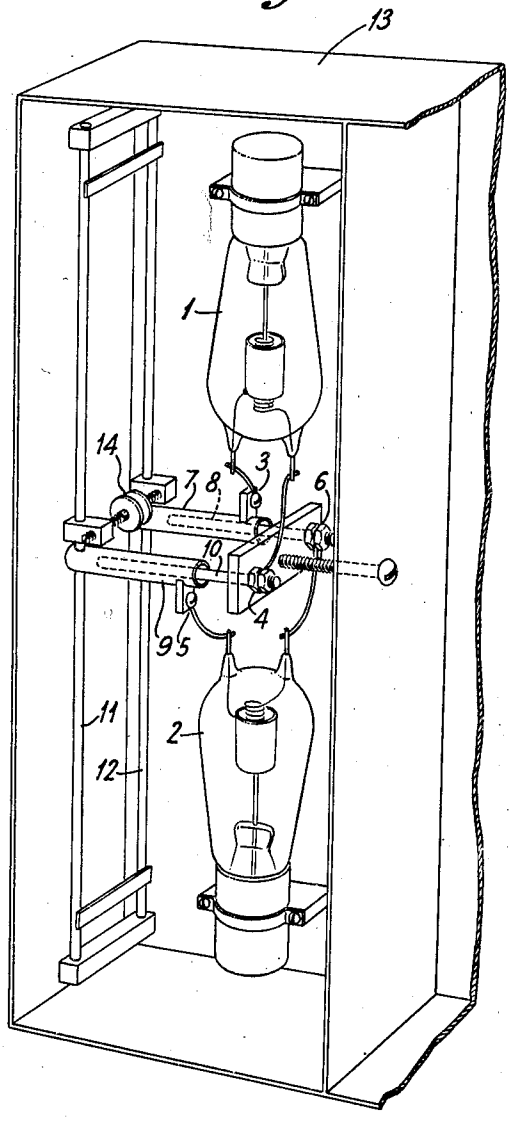
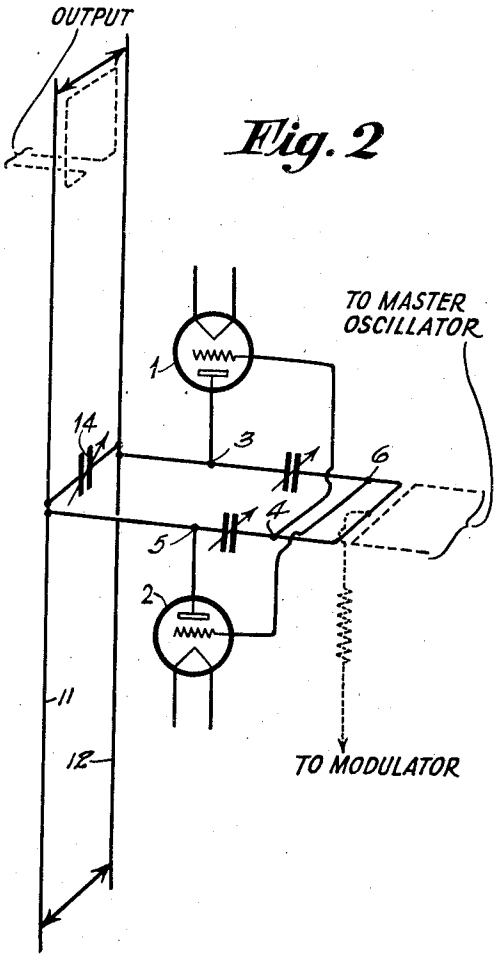


Fig. 2



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ELECTRON DISCHARGE DEVICE CIRCUIT AND MOUNTING ARRANGEMENT

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12 Claims. (Cl. 179—171)

The present invention relates to electron discharge device circuits and to a method of mounting electron discharge devices.

In communication systems using extremely high frequencies it is very important, in many instances, that connections between circuit elements be as short as possible and that stray capacities be reduced to a minimum in the interest of efficiency. This has been found to be especially true in the case of an electron discharge device amplifier circuit connected in push-pull relationship, wherein neutralizing condensers are employed.

This invention provides, among other things, a very efficient mounting for a push-pull, cross-neutralized amplifier, and satisfies the following requirements: (*a*) prevents parasitic oscillations by providing that the lengths of the connections between grid and anode terminals and neutralizing condensers be a minimum, (*b*) reduces stray capacities between input and output circuits, and (*c*) enables adjustment of neutralizing condensers.

A feature of the invention comprises the novel neutralizing capacitors which take the form of telescoping concentric metallic tubes.

Although the invention will be hereinafter described in connection with a radio frequency output stage whose equivalent circuit arrangement is a conventional, push-pull, cross-neutralized amplifier, it should be understood that the invention is not limited thereto but may be used in other circuit arrangements wherever the features thereof are desirable, such as in intermediate amplifier stages and oscillators. In the latter the feed back is sometimes controlled by partial neutralization.

Fig. 1 illustrates a pair of electron discharge device amplifiers connected in push-pull relationship and mounted in accordance with the principles of the invention; and

Fig. 2 illustrates the equivalent electrical circuit.

Referring to Fig. 1, there are shown mounted end to end, two amplifier electron discharge devices 1, 2 connected electrically in push-pull relationship. The terminals of the anode and grid electrodes of each tube are arranged to enter the envelope at the same end thereof, and both envelopes mounted so that the terminals of the electrodes of both devices are close to one another in order to minimize the lengths of the connections between electrodes as much as possible. Device 1 is here shown provided with anode terminal 3 and grid terminal 4, while device 2 is provided with anode terminal 5 and grid terminal 6. For effecting cross neutralization of the amplifier circuit there are provided, as capacitors, a pair of telescoping, concentric line cylinders 7, 8 and 9, 10, each having inner and outer separated conductors, to the outer cylinders of which the anode terminals are connected and to the inner cylinders of which the grid terminals are connected. It should be noted that the anode terminal of each device is connected to the outer cylinder of the nearest concentric line (thus 3 is connected to 7, and 5 to 9), while the grid terminal of each device is connected to the inner cylinder of the other concentric line (thus 4 is connected to 10, and 6 to 8). The value of the capacity between the inner and outer cylinders of each concentric line can be made variable by adjusting the length of the inner cylinder which is contained within the outer cylinder. Although the above described arrangement of connections between inner and outer cylinders to the grid and anode terminals, respectively, of the electron discharge devices is preferred and considered most efficient, it will be understood that the invention is not limited thereto, and that, if desired, the connections from the electrode terminals of the devices to the inner and outer terminals may be reversed.

A suitable tank circuit comprising a pair of parallel tubular conductors 11, 12 whose ends are connected together, are coupled to the outer cylinders 7 and 9 at the ends of the concentric line capacitors which are removed from the electron discharge devices, and an air condenser 14 in the form of two spaced discs connected across the conductors 11 and 12 at the center thereof.

It is preferred that the entire assembly of electron discharge devices, neutralizing capacitors and output tank circuit be mounted within a completely shielded metal box, such as 13, together with their associated oscillation and modulator circuit elements, not shown. It will be appreciated that the metal cover for box 13 has not been shown in order to more clearly reveal the electron discharge devices and other circuit elements.

Fig. 2 shows the equivalent electrical circuit of the push-pull, cross-neutralized amplifier of Fig. 1, and includes, in addition, in dotted lines, the essential input and output circuits for the amplifier. Since the electrical circuit is of somewhat conventional form and adequately described in copending application Serial No. 78,124, filed May 6, 1936, it is believed that no further reference thereto need be made.

What is claimed is:

1. In an ultra high frequency system, a pair of electron discharge devices having envelopes mounted end to end, the adjacent ends of said devices each having a grid and an anode terminal extending therefrom, a neutralizing capacitor in the form of telescoping inner and outer spaced cylinders, said outer cylinder being connected to the anode terminal of one device and said inner cylinder to the grid terminal of the other device, and another neutralizing capacitor similarly connected to the other anode and other grid electrode of said devices, said neutralizing capacitors being located in a plane at right angles to the longitudinal dimensions of said electron discharge devices.

2. In an ultra high frequency system, a pair of electron discharge devices having envelopes mounted end to end, said ends of said devices each having a grid and an anode terminal extending therefrom, a neutralizing capacitor in the form of variable telescoping inner and outer cylinders, said outer cylinder being connected at one of its ends to the anode terminal of one device and said inner cylinder to the grid terminal of the other device, another neutralizing capacitor similarly connected to the other anode and other grid electrode of said devices, and a tank circuit of parallel connected inductance and capacitance connected to the other ends of said outer cylinders.

3. Apparatus in accordance with claim 2, including means for completely shielding said devices and neutralizing capacitors.

4. Apparatus in accordance with claim 2, characterized in this that said envelopes are supported at the ends thereof removed from the ends through which the anode and grid terminals extend.

5. In a high frequency system, a pair of electron discharge devices, each having a pair of cold electrodes, a neutralizing capacitor in the form of an inner metallic cylinder and an outer metallic cylinder, said cylinders being physically separated from one another, said outer cylinder being connected to one of said electrodes of one of said devices and said inner cylinder to a non-corresponding electrode of the other device, and another similar neutralizing capacitor similarly connected to said other electrodes of said devices, said neutralizing capacitors being located in a plane at right angles to the longitudinal dimensions of said discharge devices.

6. In an ultra high frequency system, a pair of electron discharge devices having envelopes mounted end to end, the adjacent ends of said devices each having a grid and an anode terminal extending therefrom, a neutralizing capacitor in the form of telescoping inner and outer spaced cylinders, said outer cylinder being connected to the grid terminal of one device, and said inner cylinder to the anode terminal of the other device, and another neutralizing capacitor similarly connected to the other anode and other grid electrode of said devices, said neutralizing capacitors being located in a plane passing between said devices and at right angles to the longitudinal dimensions of said devices.

7. In an ultra high frequency system, a pair of vertically arranged electron discharge devices having envelopes mounted end to end, the adjacent ends of said devices each having a grid and an anode terminal extending therefrom, a neutralizing capacitor in the form of telescoping inner and outer horizontally arranged spaced coaxial conductors, said outer conductor being connected to the anode terminal of one device and said inner conductor to the grid terminal of the other device, and another neutralizing capacitor similarly connected to the other anode and other grid electrode of said devices, said neutralizing capacitors being located in a plane passing between the adjacent ends of said devices.

8. In an ultra high frequency system, a pair of vertically arranged electron discharge devices having envelopes mounted end to end, the adjacent ends of said envelopes each having grid and anode terminals extending therefrom, a pair of neutralizing capacitors arranged in a horizontal plane passing between the adjacent ends of said envelopes, each of said capacitors comprising inner and outer spaced coaxial conductors, a connection from an outer conductor of one capacitor to one terminal of one device, a connection from the associated inner conductor to a non-corresponding terminal of the other device, and similar connections from the conductors of the other capacitor to the other terminals of said devices.

9. In a high frequency system, a pair of vertically arranged electron discharge devices having envelopes mounted end to end, the adjacent ends of said envelopes each having grid and anode terminals extending therefrom, a pair of neutralizing capacitors parallelly arranged in a horizontal plane passing between the adjacent ends of said envelopes, each of said capacitors comprising inner and outer spaced coaxial conductors, a connection from one end of an outer conductor of one capacitor to one terminal of one device, a connection from the adjacent end of the associated inner conductor to a non-corresponding terminal of the other device, and similar connections from the conductors of the other capacitor to the other terminals of said devices, and a parallel tuned output circuit coupled to the other ends of said capacitors.

10. In a high frequency push-pull system, a pair of electron discharge devices, each having a pair of cold electrodes, a pair of capacitors each of which is composed of a substantially cylindrical inner conductor and a surrounding outer conductor insulatingly spaced therefrom, the inner conductor of one of said capacitors being connected at one end to one of said electrodes of one device, and the outer conductor thereof at its adjacent end to a non-corresponding electrode of the other device, said other capacitor having its conductors similarly connected to the other electrodes of said devices, and a utilization circuit coupled to one conductor of one capacitor and a corresponding conductor of the other capacitor at their other ends.

11. In a high frequency push-pull system, a pair of electron discharge devices, each having a pair of cold electrodes, a pair of capacitors each of which is composed of a substantially cylindrical inner conductor and a surrounding outer conductor insulatingly spaced therefrom, the inner conductor of one of said capacitors being connected at one end to one of said electrodes of one device, and the outer conductor thereof at its adjacent end to a non-corresponding electrode of the other device, said other capacitor having its conductors similarly connected to the other electrodes of said devices, and a tuned circuit in the form of a pair of parallel conduc-

tors coupled to said capacitors at their other ends, one conductor of said tuned circuit being coupled to one conductor of one capacitor while the other conductor of said tuned circuit is coupled to a corresponding conductor of the other capacitor.

12. In a high frequency push-pull system, a pair of electron discharge devices, each having a pair of cold electrodes, a pair of capacitors each of which is composed of a substantially cylindrical inner conductor and an outer conductor insulatingly spaced therefrom and surrounding at least a portion thereof, the inner conductor of one of said capacitors being connected at one end to one of said electrodes of one device, and the outer conductor thereof at its adjacent end to a non-corresponding electrode of the other device, said other capacitor having its conductors similarly connected to the other electrodes of said devices, and a utilization circuit coupled to one conductor of one capacitor and a corresponding conductor of the other capacitor at their other ends.

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