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DEVICE AND CIRCUIT FOR FREQUENCY TRANSLATION

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FIG. 1

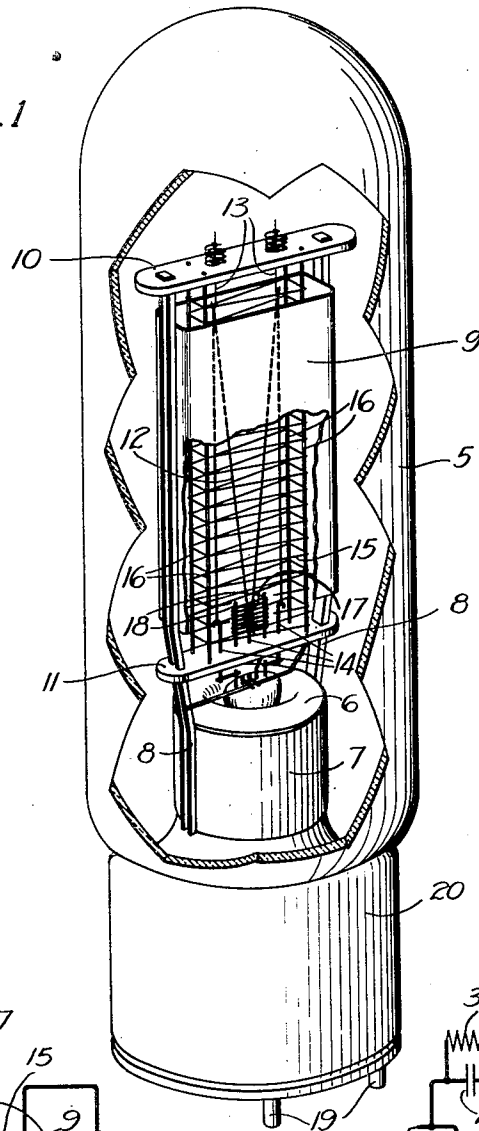


FIG. 2

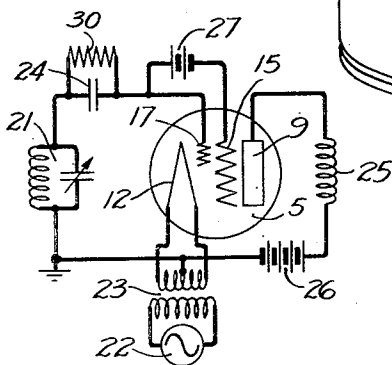
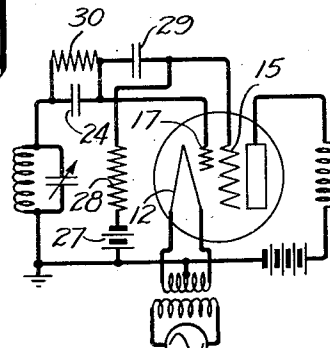


FIG. 3



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DEVICE AND CIRCUIT FOR FREQUENCY
TRANSLATION

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6 Claims. (Cl. 250—27)

This invention relates to devices and circuits for frequency translation and particularly to electric discharge detectors for radio receivers.

An object of the invention is to provide an electric discharge detector, the cathode of which may be heated with alternating current without introducing disturbances in the detected wave.

In one specific embodiment this invention comprises an electric discharge detector having, in addition to the usual cathode, anode and grid elements, an auxiliary electrode (or grid) mounted to receive electrons from only a small portion of the cathode. The received waves are applied between the cathode and auxiliary electrode through a circuit including the well known condenser-grid leak combination, the connection to the cathode being made at a mid-tap on the secondary winding of a transformer for supplying alternating current for heating the cathode. The waves are detected due to the rectifying characteristic of this cathode-auxiliary electrode circuit. The potential across the condenser-grid leak combination, which is proportional to the detected wave, is applied on the main grid which is negatively biased to prevent the flow of current between it and the cathode. The main grid cooperates with the cathode and anode to produce amplification of the detected waves.

The invention can be more readily understood by reference to the following detailed description in connection with the drawing in which: Fig. 1 is a side view partially broken away of a vacuum tube according to this invention, and Figs. 2 and 3 show diagrammatically two circuits employing the tube of this invention as a detector-amplifier.

Referring to Fig. 1, there is shown a vacuum tube 5 provided with a stem 6 on which is mounted a collar 7. Two arms 8 are supported by the collar 7. An anode 9 is supported by the arms 8. Blocks 10 and 11 of insulating material are supported at the upper and lower end of the arms 8. These blocks 10 and 11 serve as a support for the cathode and the main and auxiliary grids of the tube.

Cathode 12, which is M-shaped, is supported at the top by the resilient hooks 13 which are mounted in countersunk holes in the block 10. At the lower end, the cathode 12 is attached to hooks 14 rigidly mounted in the block 11.

The main grid 15 is spirally wound about the upright members 16 which are rigidly mounted in the blocks 10 and 11. An auxiliary grid or electrode 17 is mounted on upright members 18 rigidly supported in the block 11. The auxiliary electrode 17 surrounds only a small portion of

the central apex of the cathode 12 so as to be responsive to electrons from only a small portion of the cathode.

External connections from the electrodes of the tube are brought out to contacts 19 of well known type. Connections from the auxiliary electrode 17 may be brought out to a fifth contact, or if it is desired to use the tube in commercial type sockets, the connection from this electrode may be made to the metallic base member 20.

Fig. 2 shows a circuit for employing the vacuum tube 5 as a detector-amplifier, for example, in a radio receiving circuit. The cathode 12 of the tube 5 is heated by alternating current supplied from a source 22 through a transformer 23. Connections to the input and output circuits of the tube are made through a tap to the midpoint of the secondary winding of the transformer 23.

The output circuit may be traced from the cathode 12 through the space current battery 26 and output coil 25 to the anode. The input circuit extends from the cathode 12 through the tuned circuit 21, condenser-grid leak circuit 24—30 to the auxiliary electrode 17 and through the biasing battery 27 to the main grid or control electrode 15.

For radio reception, the high frequency signal modulated wave is selected by the tuned circuit 21 and is impressed upon the input electrodes 17—12 and 15—12 of the tube 5.

However, the biasing potential impressed upon the main grid 15 is of such magnitude that the tube 5 with respect to this grid operates on the linear portion of its input voltage-output-current characteristic curve and hence no distortion of the impressed wave is effected in the space path including the grid 15 and cathode 12.

On the other hand the circuit, including the circuit 24—30 and the space path extending between the auxiliary electrode 17 and cathode 12, operates as a grid leak detector.

The value of the condenser 24 is so chosen that the impressed radio frequency wave, comprising the unmodulated and sideband components, pass freely through it to establish a maximum potential difference at high frequency between the electrode 17 and cathode 12, whereas it operates as an open circuit for currents of the modulating or signal frequency.

Due to the rectifying action of the path including the electrode 17 and cathode 12, the modulated carrier component and the sideband compo-

nents are combined to produce the signal frequency modulating currents.

The signal frequency currents, being of much lower frequency than the impressed wave, the condenser 24 reacts thereto as though it were an open circuit. As a result the signal currents flow through the resistance 30 to build up thereacross a signal frequency potential which is impressed upon the grid 15 and cathode 12.

As a means, additional to the proper choice of voltage for the battery 27, for causing the tube 5 to operate more effectively as an amplifier of the signal currents the output coil 25 is designed to have at the signal current frequencies, an impedance which is substantially equal to the internal plate-to-cathode impedance of the tube and to have a high impedance for high frequency currents.

Since the auxiliary electrode 17 is mounted so as to receive electrons from only a small portion of the cathode 12, over which portion there is a very small difference of potential due to the alternating heating current, practically no fluctuations will be produced in the detected currents due to the alternating current.

Fig. 3 illustrates a slightly different circuit from that shown in Fig. 2.

In Fig. 3 the grid biasing battery 27 is connected directly between the cathode 12 and grid 15, in series with the grid leak resistance 28. This circuit differs from that previously described in that the battery 27 is maintained at ground potential and a blocking condenser 29 is provided so that the negative potential of the battery 27 will not be impressed on the auxiliary electrode 17. In all other respects the circuit of Fig. 3 is identical with, and operates in the same manner as, the circuit of Fig. 2.

What is claimed is:

1. In combination, an electric discharge device having an anode, a thermionic cathode, a control element, and an auxiliary electrode in operative juxtaposition to only a portion of said cathode, an input circuit including said cathode and said auxiliary electrode, means for supplying waves to be combined to said input circuit, means controlling said circuit for causing said waves to be combined, and connections for impressing the combined waves between said control element and said cathode to control the current flowing between said anode and said cathode.

2. In combination, an electric discharge device having an anode, a cathode, a control electrode and an auxiliary electrode in operative juxtaposition to only a small portion of said cathode, means for supplying waves to be combined to an input circuit including a condenser-leak resistance combination, said cathode, said auxiliary electrode and said control electrode whereby said waves are combined and the combined waves are impressed between said control electrode and said cathode to control the current flow between said anode and said cathode.

3. A radio receiving circuit comprising an electric discharge device having an anode, a cathode, an auxiliary electrode in operative juxtaposition to only a portion of said cathode and a control electrode, a source for supplying space current be-

tween said anode and cathode, a circuit including a source of signal modulated waves, said cathode and said auxiliary electrode for detecting said waves, and connections for impressing the detected waves between said control electrode and said cathode to control the flow of space current between said anode and cathode.

4. A radio receiving circuit comprising an electric discharge device having an anode, a cathode, a control electrode, and an auxiliary electrode in operative juxtaposition to only a small portion of said cathode, a source of fluctuating current for supplying heating current to said cathode, a source for supplying space current between said cathode and anode, a circuit including a source of signal modulated waves, said cathode, said auxiliary electrode and means whereby said signal modulated waves are detected, said circuit being connected at effectively the mid-point of said cathode, and connections for impressing the detected waves between said control electrode and said cathode to control the flow of space current between said anode and cathode.

5. In combination, an electron discharge device comprising an electron emitting cathode, an auxiliary electrode so positioned as to receive electrons from only a portion of said cathode, a main anode positioned to receive electrons from other portions of said cathode, and a control electrode for controlling the flow of electrons to said main anode, a circuit including a source of signal modulated waves, an impedance element and the cathode-auxiliary electrode path of said discharge device for producing the detection of the signal modulated waves due to the rectifying action of the cathode-auxiliary electrode path of said discharge device, connections for applying between said control electrode and said cathode of the signal frequency voltage produced across said impedance element, and means responsive to the amplified signal frequency energy connected between said anode and cathode.

6. In a signal receiver, an electric discharge device comprising an electron emitting cathode, an auxiliary electrode so positioned with respect to said cathode as to receive electrons from only a portion thereof, a main anode positioned to receive electrons from other portions of said cathode, and a control grid for controlling the flow of electrons to said anode, a source of signal modulated waves, an electrical network comprising a condenser having a low impedance to the signal modulated waves and a high impedance at signal frequencies and a resistance element connected in parallel, a series circuit including said source of signal modulated waves, said electrical network and the cathode-auxiliary electrode path of said discharge device for causing the detection of the signal modulated waves due to the rectifying action of the cathode-auxiliary electrode path of said discharge device, connections including a blocking condenser for supplying between the control electrode and cathode of said discharge device the signal frequency voltage produced across said resistance element, and means responsive to the amplified signal frequency energy connected between said anode and cathode.

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