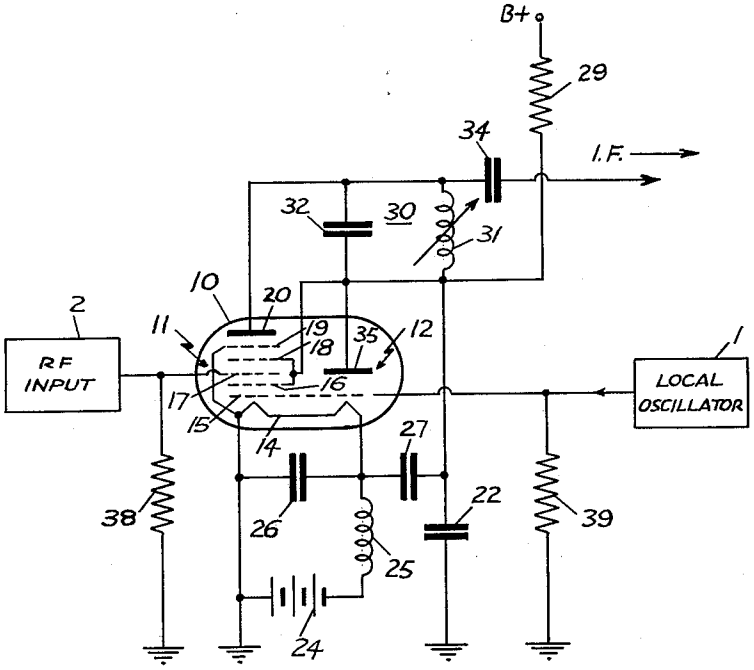
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MIXER CIRCUITS

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MIXER CIRCUITS

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This invention relates to an improved mixer circuit and more particularly relates to a triode-heptode mixer circuit of relatively high conversion gain.

Many triode-heptode mixer tubes are designed to utilize the triode section as an oscillator. Such tubes, however, may be used in circuits having a separate local oscillator tube whose output is applied to the injection grid or triode grid of the mixer. In this case, the triode section is not used as an oscillator and the triode plate is usually grounded or left floating. The conversion gain of a mixer used in this manner is relatively low.

In accordance with this invention, the plate of the triode section of the mixer tube is connected to the heptode screen and, therefore, is at a positive potential relative to the filament. Because of the increased total tube current flowing through the injection grid, as a result of the positive potential of the triode plate, the conversion gain of the mixer is considerably increased.

The drawing shows a schematic diagram of a mixer circuit according to the subject invention.

In the drawing, an electron discharge device of the well-known triode-heptode type includes an envelope **10** containing a heptode section **11** and a triode section **12**. The heptode section comprises a filament **14** which is common to both sections of the discharge device and a #1 grid **15** adjacent said filament. The #1 grid or injection grid is also common to both sections of the discharge device and may, for example, be an oval grid surrounding said filament. The heptode section further includes a #2 grid **16**, a #3 grid **17**, a #4 grid **18**, a #5 grid **19** and an anode **20**, in the order named. Although shown by way of example as a heptode, section **11** of the electron discharge device **10** may contain any number of grids so long as the input grid receptive of input from source **2** is effectively shielded from the grid of triode section **12**.

A local oscillator voltage from a separate oscillator **1** is aplied to the #1 grid **15** which functions as an injector grid of both triode and heptode sections.

An incoming signal from an R. F. source **2**, such as the R. F. section of a superheterodyne receiver, is applied to the #3 grid or signal grid **17** of the heptode section **11**. The #3 grid **17** is shielded from the plate **20** and from #1 grid **15** by screen grids **16** and **18**, both of which are held at ground R. F. potential by means of by-pass capacitor **22**. The #2 grid **16** also serves to shield the injection grid (#1 grid) **15** from the input signal grid **17**. Since the input grid **15** of both triode section **12** and heptode section **11** receptive of the signal from local oscillator **10** is in the electron stream between the common cathode **14** and the plate circuit of heptode section **11**, the voltages applied to the input grids **15** and **17** each modulate the electron stream, thus producing a beat note or intermediate frequency in the plate circuit of heptode section **11**. The #5 grid **19** is a suppressor grid and may be connected directly to the filament **14** by a connection internally of the envelope, as shown in the drawing. The power supply for the filament may be any source of direct current voltage and is shown by way of example as a battery **24**. An R. F. choke **25** isolates the filament power supply from R. F. currents. Capacitor **26** is a filter capacitor for filament **14** and capacitor **27** is a decoupling capacitor.

The heptode plate **20** is connected to the positive terminal B+ of a direct current plate supply through the plate resistor **29** and a tuned circuit **30** comprising a coil **31** shunted by a capacitor **32** and tuned to the desired difference of I. F. frequency. The output from tuned circuit **30** is coupled in the usual manner through capacitor **34** to an output circuit, such as an intermediate frequency amplifier.

The plate **35** of triode section **12** is connected to the screen grids of heptode section **11** and is thus at a potential approximating that of the plate supply. Plate **35** may be connected to any point which is positive with respect to the potential of cathode **14**. Although operation of tube **10** as a mixer is possible with plate **35** of triode section **12** floating or tied to a reference point in the circuit such as ground, owing to the fact that the local oscillator signal is applied to grid **15** which is a part of heptode section **11**, and hence, exerts an effect upon the electron stream of the heptode to whose plate circuit the I. F. output circuit is connected, a greatly increased conversion gain can be obtained with mixer tube **10** if plate **35** is maintained positive with respect to the cathode.

In a typical example using a 2G21 tube, the fixed voltage on the plate **20** and screen grids **16** and **18** of the heptode section, as well as the voltage on the triode plate **35**, were each approximately forty-five volts and the filament voltage approximately 1.25 volts. The values of the injector grid resistor **38** and input signal grid resistor **39** were twenty-two kilohms and 470 kilohms, respectively, while plate supply resistor **29** was eighteen kilohms. It should be understood that these values are merely illustrative and depend upon the type of tube, used as well as upon the particular circuit constants of the circuit in which the mixer is to be used.

This invention is not limited to the particular details of construction, materials and processes described, as many equivalents will suggest themselves to those skilled in the art. It is accordingly desired that the appended claims be given a broad interpretation commensurate wiht the scope of the invention within the art.

What is claimed is:

1. A frequency converter comprising a multisection tube including a first section and a second section, said first section having at least an electron emissive electrode, first and second input grids, a screen grid and an output electrode, said second section including said electron emissive electrode, said first input grid and an anode, first means for supplying electromagnetic energy of a first frequency to said first input grid, second means for supplying electromagnetic energy of a second frequency to said second input grid, said anode being directly connected to said screen grid.

2. A frequency converter comprising a multisection tube including a first section and a second section, said first section having at least an electron emissive electrode, first and second input grids, a screen grid and an output electrode, said second section including said electron emissive electrode, said first input grid and an anode, first means for supplying electromagnetic energy of a first frequency to said first input grid, second means for supplying electromagnetic energy of a second frequency to said second input grid, said anode being directly connected to said screen grid, and an output circuit connected to said output electrode and tuned to one of the conversion frequency products.

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