

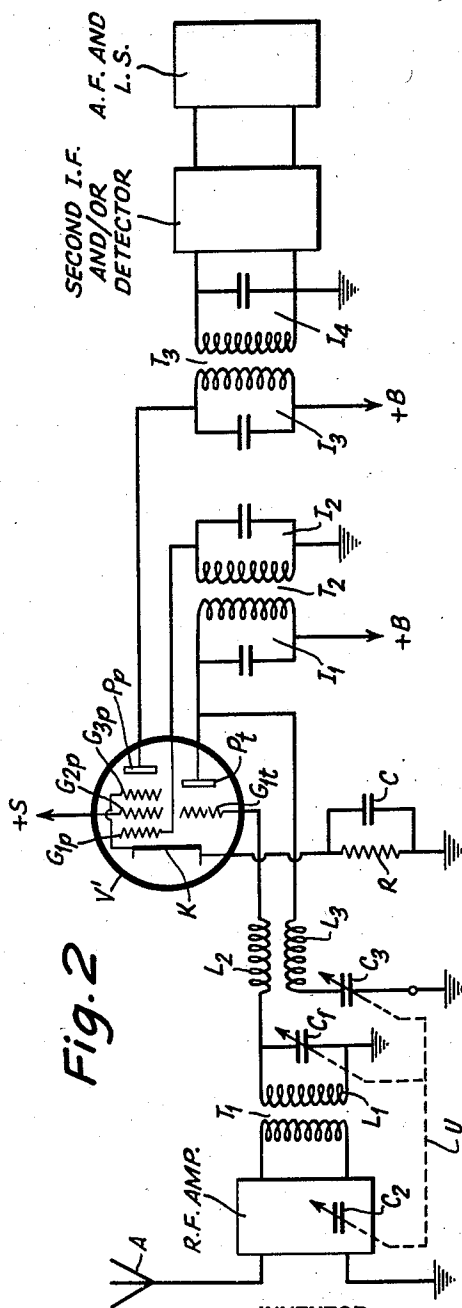
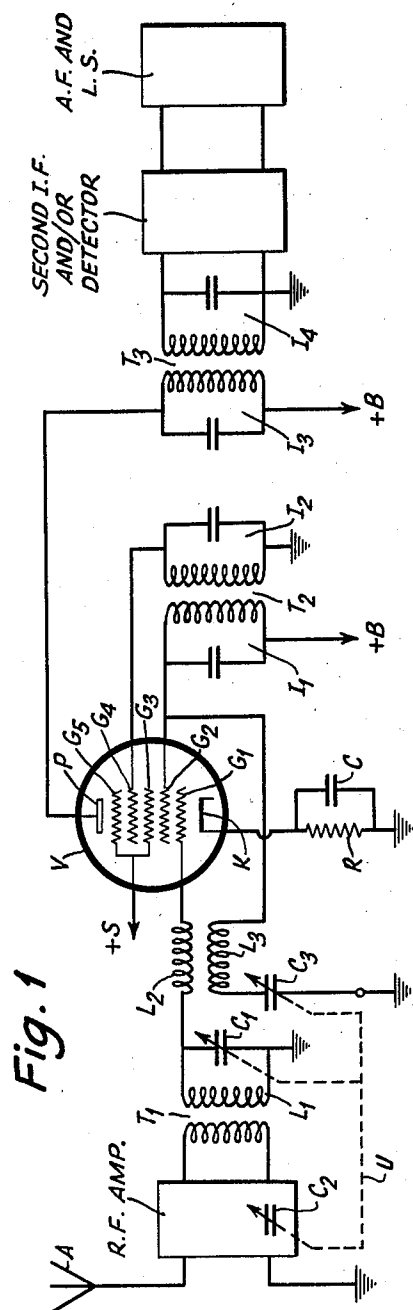
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COMBINED MIXER AND INTERMEDIATE FREQUENCY STAGE

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COMBINED MIXER AND INTERMEDIATE
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This invention is concerned with an improvement in radio receivers of the superheterodyne type and more particularly with a combined first detector-oscillator or mixer and intermediate frequency stage that may be used with advantage in such receivers.

In the present state of the art it is known to use in superheterodyne circuits a multi-electrode type of tube designed to perform simultaneously the functions of a mixer tube and of an oscillator tube. According to my present invention the same or equivalent multi-electrode tube is made to perform in addition the function of intermediate frequency amplification. As a result necessity for the use of a separate tube to perform the function of intermediate frequency amplification is dispensed with.

Other objects of the invention are to provide a circuit which would be attractive in small low-price receiving sets where the cost must be kept down to a minimum; to provide a receiver of reduced size and weight; and in battery-operated sets to provide economical operation by reducing battery consumption.

The novel features characteristic of my invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and mode of operation together with further objects and advantages thereof, will best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 and Fig. 2 illustrate preferred circuits embodying the present invention of combined mixer and intermediate frequency stages.

In the circuit of Fig. 1, the tube designated V is a multi-electrode vacuum tube and may be of the type known as "6A7" or "6A8," also known as pentagrid converters. This tube is provided with a cathode K, an output or plate electrode P and a plurality of grids G₁ to G₅ interposed in the space between K and P in the order named. In the normal use of this tube as a pentagrid converter, the cathode K, first grid G₁ and second grid G₂ have external circuit elements connected thereto to perform the function of a local oscillator for generating the local oscillations, the grid G₂ serving as the output or anode electrode of the oscillator. Received signal oscillations are impressed on the fourth grid G₄, and due to the combined action within the tube oscillations of the intermediate frequency appear in the output circuit connected to the plate P. The third and fifth grids G₃ G₅ are connected together inside the tube envelope and serve to

accelerate the electron stream and to shield electrostatically the signal control grid G₄ from voltage fluctuations on the oscillator anode-grid G₂ and the output anode P.

According to my invention the functions of the several electrodes and the connections thereto of the circuit elements are modified somewhat as will now be pointed out more particularly. In the circuit of Fig. 1 the grid G₁ serves as the signal control grid as well as the oscillator grid. Connected between the signal grid G₁ and cathode is the circuit L₁—C₁ which is tuned to the received signal oscillations. If desired, an RF amplifier stage may precede the detector-oscillator-IF amplifier tube V, the same being interposed between the antenna A and said resonant circuit L₁—C₁ through the radio frequency transformer T₁. Included in the connection to the signal grid G₁ is an inductance coil L₂ to which there is coupled an inductance coil L₃, one end of the latter being connected to the second grid G₂ which serves as the oscillator anode, the other end of the coil L₃ being connected to ground through a variable condenser C₃. The circuit comprising the elements L₃—C₃ constitutes the principal portion of a circuit which is tuned to the oscillator frequency above or below the signal frequency by the amount of the intermediate frequency. The remaining portion of this circuit is provided by the primary tuned circuit I₁ of transformer T₂ which being tuned to the intermediate frequency presents a low reactance to the oscillator frequency. It will be seen therefore that the local oscillator is constituted by the electrodes K, G₁ and G₂ and that feedback from the output to the input of said oscillator is provided by the magnetic coupling between L₂ and L₃. It will be seen also that the grid G₁ serves not only as the signal control grid for the received oscillations but also as the control grid of the local oscillator.

The variable tuning condensers C₁ and C₃, and the variable condenser C₂ of the RF amplifier, if one is used, are mechanically interconnected as shown by the dotted line U for the purpose of providing uni-control. Connected to the grid G₂ is the approximately fixed tuned circuit I₁ which is resonant to the intermediate frequency oscillations resulting from the interaction between the received signal oscillations and the locally generated oscillations. This circuit is not exactly fixed tuned since the adjustment of C₃ affects its resonant frequency, but if C₃ is small compared to the capacity in I₁, this variation in tuning is not important. Cou-

pled to the circuit I_1 is a second fixed tuned circuit I_2 also resonant to the intermediate frequency oscillations, the coils of said circuits constituting the transformer T_2 . The circuit I_2 is connected to the fourth grid G_4 , which formerly served as the signal input grid. The intermediate frequency oscillations impressed upon this grid is now amplified and appear in the output circuit of the anode P, the output circuit being constituted by the tuned intermediate frequency circuit I_3 . A fourth intermediate frequency circuit I_4 is coupled to the output circuit I_3 of tube V, the coils of said circuits constituting the transformer T_3 . The oscillations occurring in the circuit I_4 may then be further amplified in a second intermediate frequency stage or else fed directly to a second detector, the resulting audio currents being fed to an audio frequency amplifier and reproduced by a loudspeaker in the usual manner.

In order to provide suitable operating bias for the signal control and oscillator grid G_1 the cathode K has connected between it and ground the conventional self-biasing resistance-capacity network, R—C. In the event that it is desired to provide the receiver with automatic volume control, the control bias therefor may be obtained in the usual manner from the second detector and fed either to the signal grid G_1 or the IF grid G_4 , or both. The electrodes G_2 , G_3 — G_4 , and P are connected to a suitable power supply source (not shown) through the leads marked +B, +S and +B, respectively.

In the second embodiment of my invention shown in Fig. 2 I make use of the tube V' which combines in one bulb a triode and a pentode, these units being independent of each other except for the common cathode K. A representative type of tube that may be used is the "6F7" or equivalent. The triode section of the tube includes the grid G_{1t} and the anode P_t . The pentode section includes grids G_{1p} , G_{2p} , grid G_{3p} , and the anode P_p . According to this embodiment of the invention the triode section of the tube is designed to perform simultaneously the functions of local oscillator and mixer, and the pentode section serves as an intermediate frequency amplifier. The received oscillations from the tuned circuit L_1 — C_1 are fed to the triode grid G_{1t} . The circuit L_3 — C_3 — I_1 tuned to the frequency of the locally generated oscillations as explained previously is connected to the anode P_t and is coupled through the coils L_2 — L_3 to the grid G_{1t} . The resulting intermediate frequency oscillations will appear in the circuit I_1 which in turn is coupled to the circuit I_2 , the latter being connected to the first grid G_{1p} of the pentode section. Amplification of the intermediate frequency occurs in the pentode section, the amplified oscillations appearing in the load circuit I_3 connected to the plate P_p . In all other respects the circuits and functions of the various parts of the circuit shown in Fig. 2 are the same as described in connection with Fig. 1.

While I have shown and described two preferred embodiments of the invention, it will be understood that modifications and changes may be made without departing from the spirit and scope of the invention, as will be understood by those skilled in the art.

What I claim is:

1. In a superheterodyne receiver, a circuit for performing the combined functions of first detector-oscillator and intermediate frequency amplification, comprising an electron discharge

tube having within a common envelope a cathode, a plurality of grid electrodes and only two output electrodes, a tuned input circuit having impressed thereon the received signal oscillations connected between cathode and one of the grid electrodes, external circuit elements connected between said latter grid electrode, cathode and one of the output electrodes to serve as a generator of local oscillations, a first intermediate frequency circuit connected to said one output electrode, a second intermediate frequency circuit coupled to the first intermediate frequency circuit connected to one of the other grid electrodes, and a third intermediate frequency circuit connected to the second output electrode.

2. A circuit as defined in claim 1 wherein the external circuit elements comprises an inductance coil connected to the grid electrode to which the signal input circuit is connected, a second coil in coupled relation to the first connected to said one output electrode, and a variable condenser connected to the second coil and forming therewith a tuned circuit resonant to the frequency of the locally generated oscillations.

3. In a superheterodyne receiver, a circuit for performing the combined functions of first detector-oscillator and intermediate frequency amplification, comprising an electron discharge tube having within a common envelope a cathode, a plurality of grid electrodes and a single anode electrode, a tuned input circuit having impressed thereon the received signal oscillations connected between cathode and one of the grid electrodes, external circuit elements connected between said latter grid electrode, a second grid and cathode to serve as a local oscillator, a first circuit tuned to the intermediate frequency oscillations resulting from the interaction between the received and local oscillations connected to said second grid electrode, a second circuit tuned to the intermediate frequency oscillations coupled to the first intermediate frequency circuit and connected to a third grid electrode, and an output circuit also tuned to the intermediate frequency oscillations connected to the anode electrode.

4. In a superheterodyne receiver, a circuit for performing the combined functions of first detector-oscillator and intermediate frequency amplification, comprising an electron discharge tube having within a common envelope a cathode, a single anode electrode and a plurality of grid electrodes interposed in the space between cathode and the anode electrode, a tuned input circuit having impressed thereon the received signal oscillations connected between cathode and the first grid electrode next adjacent the cathode, a coil included in the connection between the input circuit and the first grid, a circuit having a coil in coupled relation to the first grid coil tuned to locally generated oscillations and connected between cathode and a second grid electrode, a first intermediate frequency circuit connected to said second grid electrode, a second intermediate frequency circuit coupled to the first intermediate frequency circuit connected to a third grid electrode, and a third intermediate frequency circuit connected to the anode electrode.

5. In a superheterodyne receiver, a circuit for performing the combined functions of first detector-oscillator and intermediate frequency amplification, comprising an electron discharge

having within a common envelope electrodes constituting a triode and other electrodes constituting a pentode, the triode and pentode having a common cathode, a tuned input circuit having impressed thereon the received signal oscillations connected to the triode grid electrode, a circuit tuned to locally generated oscillations connected to the triode anode and being in coupled relation to the triode grid circuit, a first intermediate frequency circuit connected to the triode anode, a second intermediate frequency circuit coupled to the first intermediate frequency circuit connected to the signal grid electrode of the pentode, and a third intermediate frequency circuit connected to the pentode anode electrode.

6. A circuit as defined in claim 5 wherein an inductance coil is connected between the tuned input circuit and the triode grid electrode, and the circuit which is tuned to the locally generated oscillations comprises a variable condenser and a second inductance coil in coupled relation to the first coil.

7. In a superheterodyne receiver, a circuit for performing the combined functions of producing an intermediate frequency by mixing the received signal oscillations with locally generated oscillations and amplifying such intermediate frequency, comprising an electron discharge tube having within a common envelope a cathode and an anode electrode between which an electron stream is produced, a plurality of grid electrodes interposed in said electron stream between cathode and anode electrode, an input circuit tuned to the received signal oscillations connected between cathode and one of the grid electrodes, a coil included in the connection between the

input circuit and said grid, a circuit tuned to locally generated oscillations connected between cathode and another grid electrode and having a coil in coupled relation to the first coil, a first intermediate frequency circuit connected to the latter grid electrode, a second intermediate frequency circuit coupled to the first intermediate frequency circuit connected to a third grid electrode, and a third intermediate frequency circuit connected to the anode electrode.

8. In a superheterodyne receiver, a circuit for performing the combined functions of producing an intermediate frequency by mixing the received signal oscillations with locally generated oscillations and the amplification of such intermediate frequency, comprising an electron discharge tube having within a common envelope a cathode and an anode electrode between which an electron stream is produced, a plurality of grid electrodes interposed in said electron stream between cathode and anode electrode, an input circuit tuned to the received signal oscillations connected between cathode and the first grid electrode next adjacent the cathode, a coil included in the connection between the input circuit and said first grid, a circuit having a coil in coupled relation to the first grid coil tuned to locally generated oscillations and connected between cathode and a second grid electrode, a first intermediate frequency circuit connected to said second grid electrode, a second intermediate frequency circuit coupled to the first intermediate frequency circuit connected to a third grid electrode, and a third intermediate frequency circuit connected to the anode electrode.

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