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SUPERHETERODYNE CONVERTER NETWORK

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Fig. 1

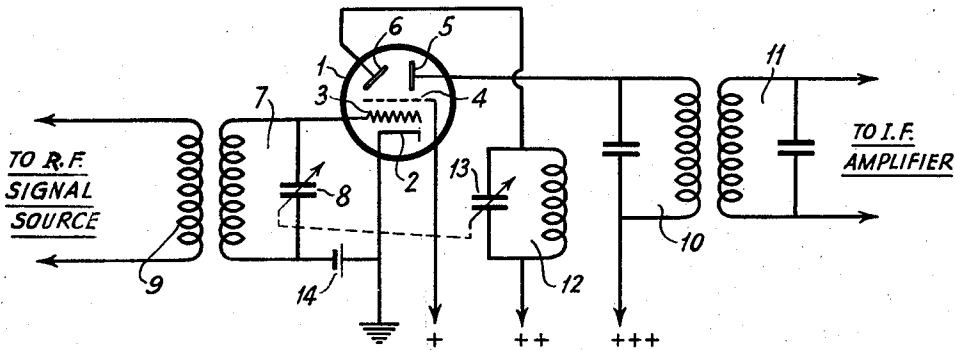


Fig. 2

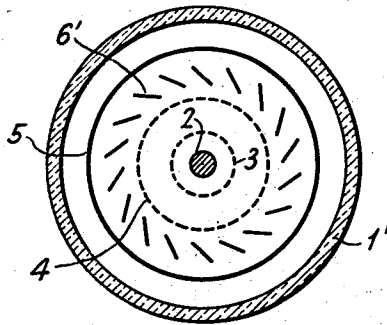
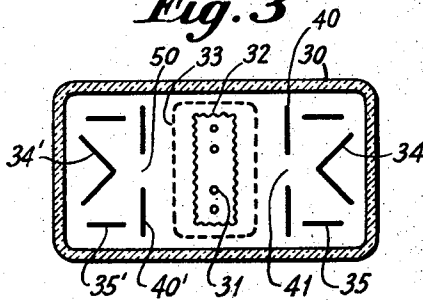


Fig. 3



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SUPERHETERODYNE CONVERTER NETWORK

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2 Claims. (Cl. 250—20)

My present invention relates to superheterodyne converter networks, and more particularly to combined local oscillator-first detector circuits for receivers of the superheterodyne type.

5 It may be stated that it is one of the main objects of my present invention to provide a converter network for a superheterodyne receiver, wherein the network utilizes an electron discharge tube whose electrodes are geometrically
10 related in such a manner, and energized in such a fashion, that one of the electrode circuits of the tube has a negative resistance characteristic imparted to it whereby it is capable of functioning as the local oscillator circuit of the converter network.

15 Another important object of the invention is to provide in the first detector-local oscillator circuit of a superheterodyne receiver, a tube having a local oscillator electrode circuit adapted to function as a local oscillator by virtue of secondary emission from the oscillator electrode to another electrode whose direct current potential is more positive than the oscillator electrode.

20 Another object of the invention is to provide a tube adapted for use in the converter network of a superheterodyne receiver, and which tube includes a local oscillator electrode whose direct current potential is positive, but less positive in magnitude than the I. F. output electrode of the
30 tube, and which tube functions to produce local oscillations by virtue of a negative resistance characteristic being imparted to the local oscillator electrode.

35 Still other objects of the invention are to improve generally the simplicity and efficiency of converter networks of superheterodyne receivers, and more especially to provide converter networks that are not only reliable in operation, but economically manufactured and assembled in
40 radio receivers.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims; the invention itself, however, as to both its organization and operation will best be understood by reference to the following description taken in connection with the drawing, in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect.

50 In the drawing, Fig. 1 is a circuit diagram of a converter network embodying the invention;

Fig. 2 is a circuit diagram of a cross sectional view of an electron discharge tube which is adapted to be employed in a converter network
55 embodying the invention;

Fig. 3 is a cross section of a modified form of tube adapted for use with this invention.

Referring now to the accompanying drawing, wherein like reference characters in the different figures designate similar elements, there is shown
5 in Fig. 1 that portion of a superheterodyne receiver which is involved in the present invention. It will be observed that the numeral 1 is an electron discharge tube provided with a cathode 2, a signal input grid 3, a shield grid 4, an output
10 anode, or plate, 5, and an oscillator electrode 6. The tunable signal input circuit 7 is connected between the signal grid 3 and cathode 2, and the numeral 8 designates the variable tuning condenser usually employed to tune the signal input
15 circuit of the converter network. The tuning range of the input circuit 7 may be in the broadcast band which is 500 to 1500 k. c.

If the receiver is of the multi-band type, means well known to those skilled in the art may be used to tune the input circuit through one, or more,
20 signal frequency ranges. The numeral 9 denotes a signal input means coupled to the input circuit 7. For example, this may be a signal collector of the grounded antenna type, or it may be a
25 collector used on a mobile construction such as an automobile. The I. F. output circuit 10 is connected to the output electrode 5, and circuit 10 is coupled to the input circuit 11 of the following I. F. amplifier. It will be understood that each
30 of circuits 10 and 11 is fixedly resonated to the operating I. F., and this frequency would in accordance with present practice be chosen from a range of 175 to 465 k. c.

In circuit with the electrode 6 there is connected the tunable oscillation circuit 12, and the
35 latter includes the tuning condenser 13. Those skilled in the art are fully aware of the fact that the rotors of the condensers 8 and 13 are arranged for mechanical uni-control. The numeral
40 14 designates the negative bias voltage source usually inserted between the grid 3 and the cathode 2, and which source provides the normal negative operating bias for the signal grid 3. The I. F. amplifier may comprise one, or more,
45 stages of amplification, and this amplifier will be followed by a second detector; the latter in turn will feed one, or more, stages of audio amplification, and finally terminate in any desired type of
50 reproducer.

As shown in Fig. 1, each of electrodes 4, 5 and 6 have applied to them positive potentials. However, the positive potential on the electrode 5 is greater than that on electrode 6, and the positive potential on the screen electrode 4 is less
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than that on electrode 6. Merely by way of illustration it is pointed out that the positive potential on the electrode 5 may be of the order of 200 volts, while that on the electrode 6 may be of the order of 100 volts. The positive potential of the electrode 4 may be chosen to be less than 100 volts, but is to be sufficiently high to enable the grid 4 to draw sufficient electrons through it to the electrode 6.

In Fig. 2 there is shown a cross section of an electron discharge tube which may be used for the tube 1. Such a tube comprises the usual envelope 1', and this may be glass or metal, and the remaining electrodes are disposed within the envelope. Thus, the numeral 5 denotes the cylindrical output electrode, and the numeral 6' denotes the oscillator electrode. It will be observed that the electrode 6', schematically shown by the numeral 6 in Fig. 1, is made up of a plurality of angularly disposed vertical slat-like electrodes, arranged to be more or less overlapping. This arrangement may be easily secured by forming into cylindrical shape a strip of metal which has been stamped out in ladder design, with each stamped out portion, or rung, given a twist. The numeral 4 denotes the shield electrode disposed between the oscillator electrode 6' and the signal control grid 3; numeral 2 denotes the axially arranged cathode. It is believed that those skilled in the art are fully aware of the entire construction of a tube of the general type shown in Fig. 2, and it is thought that a cross-sectional view is sufficient to inform such skilled persons in the manner of constructing the tube electrodes.

In considering the operation of the circuit shown in Fig. 1, it is pointed out that electrons drawn through the openings in the positive shield grid 4 nearly all impinge upon the face of the electrode 6 due to the overlapping arrangement. Secondary electrons are emitted from the faces of the slats of electrode 6, and are drawn towards the electrode 5 because of the higher positive potential of the electrode 5. This results in the circuit connected to electrode 6 having a negative resistance characteristic, and, hence, the circuit 12 functions as the local oscillator circuit. At any setting of the uni-control tuning means there will be produced in the output circuit 10 I. F. energy whose frequency value is equal to the frequency difference of the adjusted frequencies of input circuit 7 and oscillator circuit 12. It will, therefore, be seen that the circuit is of the dynatron type, and the electrode 6 functions as the dynode, but that contrary to the known dynatron arrangements, the potentials of the screen and plate electrodes are arranged as in an ordinary screen grid amplifier, instead of having the highest potential applied to a screen electrode as in the usual dynatron circuit.

Fig. 3 shows a cross section of another electron discharge tube which may be used in place of tube 1. Such a tube will be seen to comprise the envelope 30 which has disposed within it a cathode 31. Surrounding this cathode is arranged a control grid 32, and the positive shield grid 33 surrounds the control grid 32. The numeral 34 denotes the dynode electrode whose angularly disposed faces are arranged at approximately 45 degrees with respect to a line passing through the intersection of the faces of the electrodes. A second pair of dynode faces 34' are disposed in diametrically opposed relation to electrodes 34. The I. F. output electrodes are denoted by the numerals 35 and 35'. It will be seen that there is disposed adjacent each dynode

electrode face an output electrode 35. A concentrator, or focusing, electrode 40 is disposed between the shield electrode 33 and the line of intersection of the dynode electrode faces, and it will be observed that there is thus provided a focusing aperture 50 for the dynode 34', and a second focusing aperture 41 for the dynode 34.

The focusing electrodes 40 and 40' may be at cathode potential, or may be given a certain amount of positive or negative potential, so as to insure a sufficient focusing efficiency of these electrodes without too great a reduction of current to electrodes 34 and 34'. It is pointed out that this type of tube functions substantially in the same manner as that shown in Fig. 2. From the dynode faces secondary electrons are emitted, and these secondary electrons are collected by the output electrodes 35 and 35'. By virtue of such secondary electron emission, the dynodes 34 and 34' impart to the oscillator circuit connected thereto a negative resistance characteristic. Of course, the faces of the dynode electrode surfaces may be treated in known manner to increase the secondary emission efficiency of the dynodes. It will be observed that the general cross-sectional configuration of the tube in Fig. 3 is rectangular, whereas in the case of the tube of Fig. 2 it is circular.

It has been stated that signals are impressed on electrode 3, oscillations are generated on electrode 6, and I. F. taken out from electrode 5. Without going into a detailed discussion of the mechanism of frequency conversion, it is sufficient to note that it is well known that I. F. is produced in both dynode and output electrode circuits when the oscillation strength is modulated by signals applied to an inner control grid. The output electrode current depends upon the oscillation strength, and when this is caused to vary by means of signals, the plate current varies in accordance with the beat frequency or difference of frequency between the signals and the local oscillator frequency.

While I have indicated and described several circuit arrangements for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular circuit and tube arrangements shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. In a superheterodyne converter network, an electron discharge tube provided with at least a cathode, a signal input electrode, an output electrode and an auxiliary electrode, means for maintaining the output electrode at a more positive potential than the auxiliary electrode, and both said auxiliary and output electrodes being at a positive potential with respect to the input electrode and cathode, said auxiliary electrode being geometrically arranged with respect to the control electrode and output electrode in such a manner that secondary electrons are emitted from the auxiliary electrode, said geometric arrangement being such as substantially to oppose the flow of electrons from the cathode direct to the output electrode whereby the output electrode current consists chiefly of secondary electrons from the auxiliary electrode, a signal input circuit connected between the cathode and control grid, a local oscillator circuit connected to the auxiliary electrode, and an intermediate fre-

quency output circuit connected to the output electrode.

2. In a superheterodyne converter network, an electron discharge tube provided with at least a cathode, a signal input electrode, an output electrode and an auxiliary electrode, means for maintaining the output electrode at a more positive potential than the auxiliary electrode, and both said auxiliary and output electrodes being at a positive potential with respect to the input electrode and cathode, said auxiliary electrode being geometrically arranged with respect to the control electrode and output electrode in such a

manner that secondary electrons are emitted from the auxiliary electrode, a signal input circuit connected between the cathode and control grid, a local oscillator circuit connected to the auxiliary electrode, and an intermediate frequency output circuit connected to the output electrode, the emission of said auxiliary electrode being disposed at approximately an angle of 45 degrees with respect to the output electrode whereby the output electrode current consists chiefly of secondary electrons from the auxiliary electrode.

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