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SUPERHETERODYNE FREQUENCY CHANGING CIRCUITS

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Fig. 1

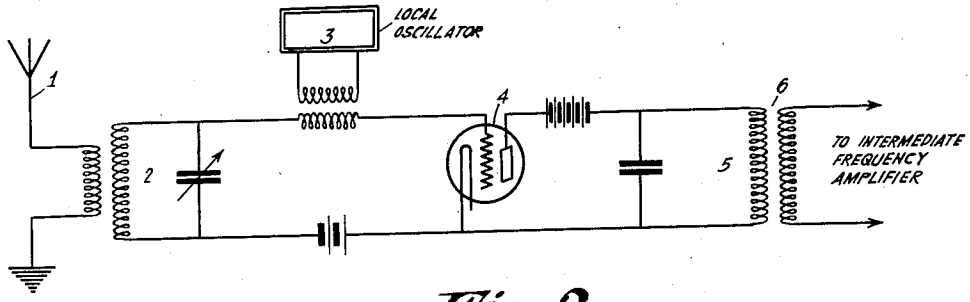


Fig. 2

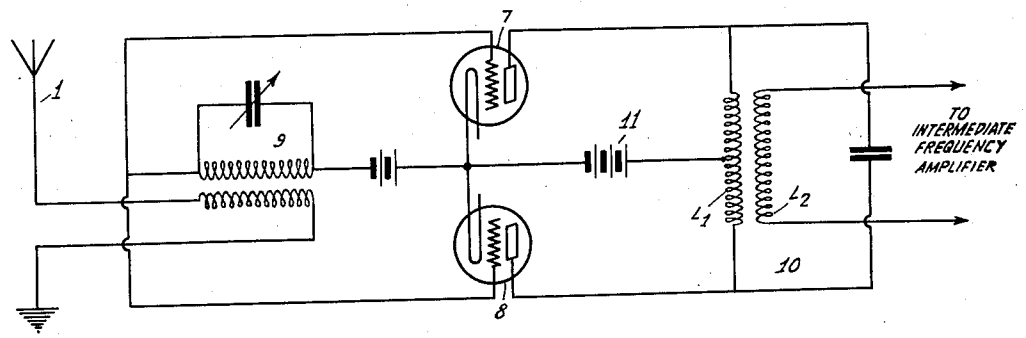
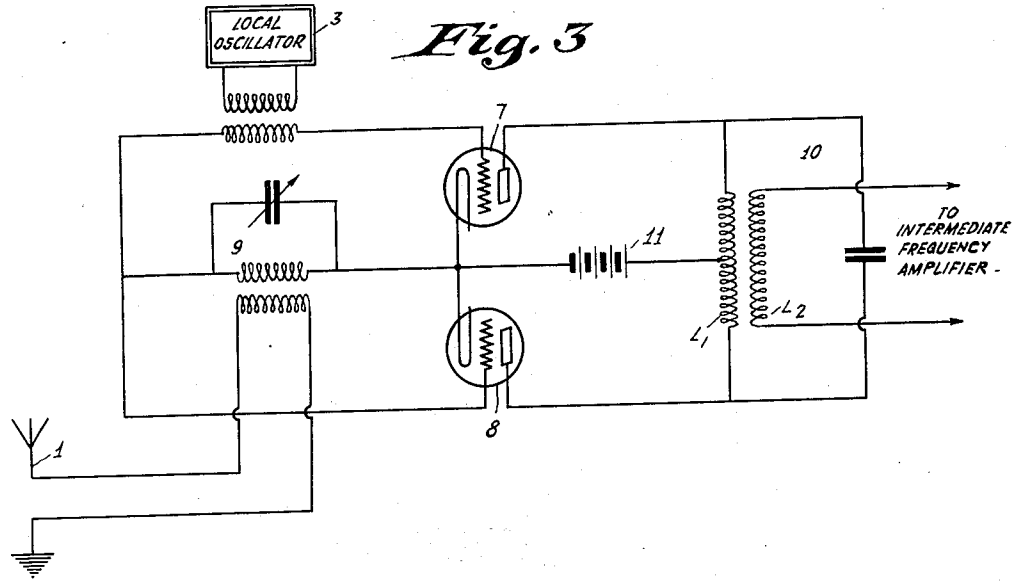


Fig. 3



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SUPERHETERODYNE FREQUENCY CHANGING CIRCUITS

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5 Claims. (Cl. 250—20)

This invention relates to a superheterodyne receiving circuit in which the intermediate frequency is derived in a new and efficient manner.

The primary object of this invention is to provide means for obtaining an intermediate frequency in a superheterodyne receiving circuit by combining the local oscillator frequency and the incoming signal modulated radio frequency without the possibility of interference from signals of other than the desired wave length.

Other objects and novel features which I believe to be characteristic of my invention are set forth in what follows and with particularity in the appended claims.

My invention, however, as to its organization and method of operation will best be understood by reference to the following description taken in connection with the accompanying drawing in which;

Figure 1 shows a typical frequency changing arrangement for superheterodyne reception;

Figure 2 shows Figure 1 doubled, however, with the plate circuits in opposition; and,

Figure 3 shows a preferred embodiment of my invention in which the intermediate frequency is obtained from the desired signal and the local oscillator free from intermediate frequency currents produced from undesired signals.

In Figure 1, an antenna 1 is shown coupled to a tuned circuit 2 which is tuned to the signal. As will be noted tuned circuit 2 forms a portion of the input circuit of space discharge device 4. A local oscillator 3 is provided for impressing locally generated oscillations in the input circuit of tube 4. The output of tube 4, a portion of which is constituted by the tuned circuit 5, is tuned to an intermediate frequency and as is usually the custom the tuned output circuit is coupled to an intermediate frequency amplifier of any desired form through a transformer 6. It is a disadvantage of this simple arrangement that even if the local oscillations or heterodyne is not applied, intermediate frequency currents may be produced in the output circuit of the tube 4 by a simultaneous reception of two incoming frequencies differing from each other by the frequency to which the intermediate frequency amplifier is tuned, or by the simultaneous reception of two frequencies whose sum is equal to the intermediate frequency, or by the reception of a single frequency one of whose harmonics is equal to the intermediate frequency, or by the reception of a signal which is equal to the intermediate frequency. As is evident these effects are likely to be causes of serious imperfections in the operation of the simple superheterodyne circuit illustrated in Figure 1.

In addition to the disadvantages enumerated above there is the possibility of intermediate frequency currents being produced by combinations of various frequencies applied to the grid of tube 4. However, as to these latter mentioned difficulties it is well known that in the majority of cases they are not apt to be serious. In the present state of the art it is customary to minimize the first mentioned effects by employing a signal selecting system capable of such selectivity that only the desired frequency reaches the grid of the frequency changing tube and in addition to this so choosing the intermediate frequency that it will not be equal to any harmonic of any of the signal frequencies to be received.

In what follows the term "symmetrically coupled" or equivalent expressions when applied to the inputs of the two space discharge devices is to be construed as meaning that the energy impressed upon said inputs through said coupling affects the grids of the devices in phase consonance.

In Figure 2 I have shown a system somewhat similar to a doubled showing of Figure 1 except that the output circuits of the tubes 7 and 8 are connected in opposition to each other. In said figure, 1 represents the antenna in which high frequency signal energy is received, 9 corresponds to the tuned circuit 2 of Figure 1 except that in the case of Figure 2 the voltages impressed upon tuned circuit 9 are in turn impressed upon the grids of the two space discharge devices 7 and 8 in like sense, and tuned circuit 10 of Figure 2 corresponds to the output circuit 5 of Figure 1. It will be noted that coil L_1 of circuit 10 is arranged so as to be one half in the output circuit of device 7 and one half in the output of device 8. Coupled to the coil L_1 by means of a coil L_2 arranged so as to be coupled to both halves of L_1 is an intermediate frequency amplifier circuit. It will be noted that in Figure 2 since upon the receipt of a signal in antenna 1 the same charge is placed upon each of the grids of tubes 7 and 8 and since the output circuits of said tubes are connected in opposition any and all output currents resulting from the application of voltage to the grids are cancelled out in the differential transformers L_1, L_2 provided that the connection to L_1 from the B battery 11 and the couplings between L_2 and the two halves of L_1 are so adjusted that the effect of voltage on one grid in producing voltage in L_2 is exactly neutralized by the effect of the

voltage on the other grid. The simplest case where the above cancellations of output currents occurs is where the two tubes 7 and 8 used have identical characteristics and the so-called plate current source is connected to the midpoint of L_1, and L_2 is coupled to the two halves so formed of L_1. It will be evident that with the arrangement shown in Figure 2 freedom from intermediate frequency currents in L_2 produced by any combination of input frequencies or harmonics thereof is achieved. However, in such an arrangement there are no means provided for producing intermediate frequency currents in response to the desired signal.

To obtain intermediate frequencies from the desired signal while retaining freedom from intermediate frequency currents produced in the undesired fashions enumerated in connection with the description of Figure 1, I have devised the scheme shown in Figure 3 in which 1 represents the antenna for receiving high frequency energy, 7 and 8 are the two space discharge devices connected as described in Figure 2, 10 is the tuned output circuit to which by means of L_1, L_2 is coupled an intermediate frequency amplifier and 11 is the usual "B" battery. However, Figure 3 differs from Figure 2 in that a local oscillator 3 is coupled to the input circuit of tube 7. In Figure 3 when the source of local oscillations or so-called heterodyne is connected as shown intermediate frequency current will be produced in the tube 7 by the beats between the heterodyne and the signal. It is evident that the same results will be obtained when the heterodyne is applied to both grids in the same phase while the signal is applied to the input of the tube 7 which result can be achieved by simply interchanging the positions of the heterodyne and the signal inputs of Figure 3. However, the better practice is the arrangement as shown in Figure 3 because if the two energy sources are interchanged, in the absence of the heterodyne the odd harmonics of the signals including the fundamental are not cancelled out by the differential transformer. The circuit of Figure 3 is furthermore preferred for the reason that the rotor of the tuning condenser may be kept at an unvarying potential.

It will be noted that in my invention as above described an untuned input circuit may be employed in place of the tuned input circuit in which case various stations may be selected by simply varying the heterodyne frequency. The only serious interference which may result from not tuning the signal input is the possibility of intermediate frequency being produced by an interfering frequency as much higher than the heterodyne as the heterodyne is higher than the desired signal. Of course, this is assuming that the heterodyne is to be operated at a frequency above that of the signal. There is also the possibility of intermediate frequency current being produced by an interference whose frequency plus the frequency of the heterodyne is equal to the intermediate frequency. However, in such a case by suitable choice of the intermediate frequency all such possible interfering frequencies may be made to lie outside the range of frequencies which are to be received so that by the use of a fixed band pass filter or its equivalent located between the antenna 1 of Figure 3 and the input 9 of the frequency changing system all of these interfering frequencies may be suppressed without the recourse of any element that requires readjusting when changing from one desired signal to another. The band pass filter, of course, must be designed so as to pass all the desired frequencies. It will be evident that by this arrangement a superheterodyne receiver may be built which can be tuned by the variation of only one element, namely, the heterodyne tuning condenser and which is nevertheless free from the more serious sources of interference which occur when the same result is attempted using the simple frequency changing arrangement shown in Figure 1.

It is to be understood, that the invention is not limited to the particular application shown.

I claim:

1. In a superheterodyne receiver a frequency changing circuit comprising a pair of electronic tubes, push-pull output circuits therefor, input circuits for said tubes including a common portion, a source of high frequency signal energy, a source of heterodyning frequency energy, means for impressing energy from one of said sources across the common portion of the input circuits of both tubes whereby energy from said source affects both tubes in phase consonance, means for impressing energy from the other of said sources across a portion of the input circuit of only one of said tubes and an intermediate frequency amplifier differentially coupled to the push-pull output circuit of said tubes.

2. In a superheterodyne receiver, a frequency changing system comprising a pair of space discharge devices arranged in push-pull, a circuit tuned to the frequency of desired incoming signal oscillations connected in the common portion of the input circuits of said devices, the output circuits thereof being tuned to a desired intermediate frequency, a circuit for the reception of high frequency signals coupled to said first mentioned tuned circuit and a circuit containing a local source of high frequency energy coupled to the input circuit of one of said devices.

3. In radio receiving apparatus of the superheterodyne type a frequency changing system comprising a pair of space discharge devices, push-pull output circuits therefor, input circuits for said devices including a common portion, an energy absorption system, a circuit tuned to the frequency of desired incoming signal oscillations connected in the common portion of said input circuits whereby energy impressed thereon will affect both said space discharge devices equally and in the same sense as regards phase and amplitude, means for coupling said absorption circuit to the tuned circuit, means for tuning said push-pull output circuits of said space discharge devices to an intermediate frequency and a local oscillator connected to the input circuit of at least one of said space discharge devices.

4. In a superheterodyne receiver, a frequency changing system comprising a pair of electron discharge devices, push-pull output circuits therefor, input circuits therefor including a common portion, a circuit for the reception of signalling energy, a source of heterodyning frequency energy, means for coupling said reception circuit to the common portion of the input circuits of said space discharge devices, means for coupling said heterodyning circuit to the input circuit of one of said devices, an intermediate frequency amplifier and means for coupling said amplifier to the push-pull output circuits of said space discharge devices.

5. A frequency changer circuit for superhet-

erodyne receivers and the like comprising a pair of translating devices having input and output circuits, a circuit for the reception of high frequency signals, a second circuit containing a local source of high frequency energy, means for symmetrically coupling one of said circuits to said input circuits whereby energy transferred through said means affects both devices in phase consonance, means for coupling the other of said circuits to the input circuit of only one of said devices and a beat frequency amplifier circuit differentially connected to said output circuits.

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