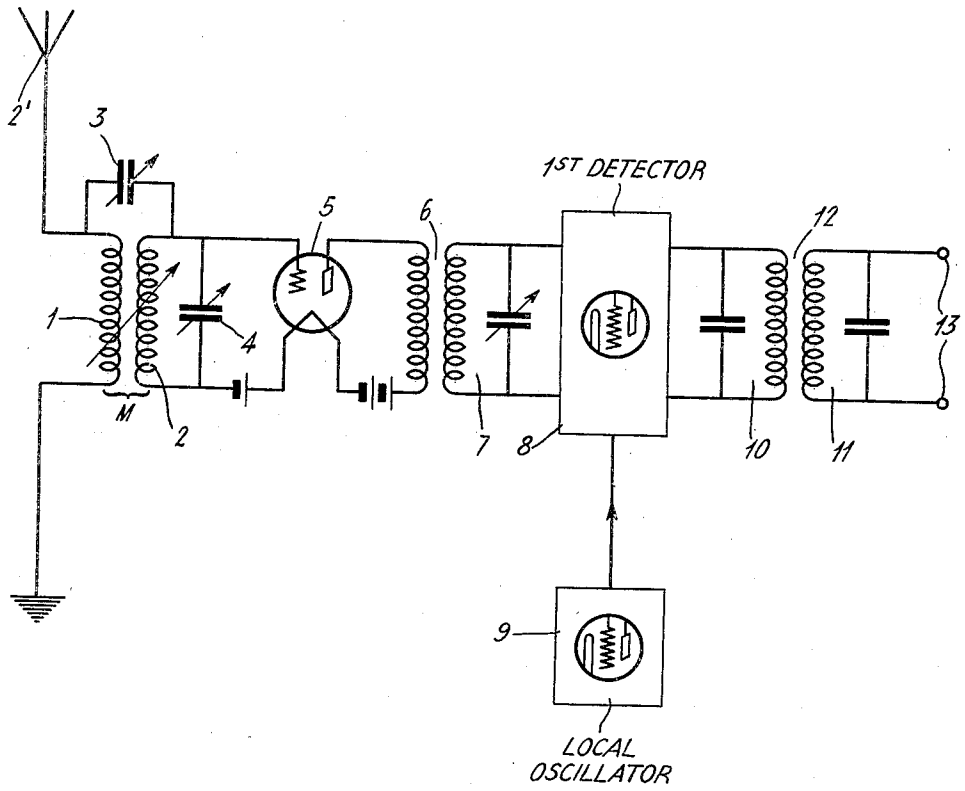
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SUPERHETERODYNE RECEIVER

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SUPERHETERODYNE RECEIVER

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It is an object of this invention to provide a superheterodyne receiver in which means are provided to prevent the transmission of signals having a frequency of the intermediate frequency of the receiver to the first detector thereof but which at the same time efficiently transmits the desired signal frequency thereto.

A further object of the invention is to provide a radio frequency transformer in which both inductive and capacity couplings are provided between primary and secondary windings for the purpose of passing the signal frequency and at the same time attenuating to a very great extent the intermediate frequency. I prefer to arrange the coupling between the primary and secondary windings of the transformer so that the coupling provided by the capacity or condenser connecting them is opposed or substantially 180° out of phase with the inductive coupling between the windings.

Other objects of the invention will become apparent to those skilled in the art as the description thereof proceeds.

For a better understanding of the invention, however, reference is made to the following specification and the accompanying drawing in which the single figure is a schematic circuit diagram of a portion of a superheterodyne radio receiver embodying the invention.

Referring to the drawing, the antenna circuit 2' is shown coupled to the grid of an amplifier tube 5 through the primary and secondary windings 1 and 2, the secondary being tunable to the desired signal frequency by the variable condenser 4. The output circuit of the amplifier 5 is shown connected to the tuned input circuit 7 of the first detector 8 by the transformer 6 and local oscillations are also impressed upon the detector by means of the local oscillator 9. The output circuit of the detector is connected to a pair of output terminals 13 through a transformer 12 whose primary and secondary windings comprise portions of the tuned circuits 10 and 11 which are preferably tuned to the intermediate frequency of the receiver. The remainder of the receiver may be of a type well known to those skilled in the art and may for example, be of the type disclosed in Figs. 2 and 3 of Armstrong Patent #1,342,885 issued June 8, 1920. It is also understood that the first detector and local oscillator may be of any preferred known type, such as those disclosed in the above Armstrong patent, my invention being adapted for use with any known type of detector and oscillator arrangement in a superheterodyne receiver.

I have found that by providing capacity coupling between the primary and secondary windings 1 and 2 and so poling the primary winding that this capacity coupling is opposed to or substantially 180° out of phase with the inductive coupling between these windings, as by means of the condenser 3 connected as shown, any energy of the intermediate frequency picked up on the antenna 2' may be substantially attenuated and prevented from being impressed on the grid of tube 5 while at the same time, there will be very little attenuation of the desired signal frequency current. I have found that when the inductive coupling is small this attenuation of the intermediate frequency is a maximum when

$$K = f \times 2\pi\sqrt{MC},$$

wherein

K=coefficient of coupling between primary and secondary windings, $=\frac{M}{\sqrt{L_1 L_2}}$

f=intermediate frequency of receiver,

M=mutual inductance between windings 1 and 2,

C=capacity value of condenser 3.

I have shown the capacity coupling between the windings as provided by a variable condenser 3 which may be adjusted to provide the desired amount of such capacity coupling and also my invention contemplates the variation of the mutual inductance between the windings in any known manner, as indicated by the arrow. These means permit both the inductive and the capacity coupling to be adjusted to the proper values to attenuate any particular intermediate frequency which it is desired to utilize in the receiver. In a superheterodyne receiver receiving signals over the broadcast range of from 550 to 1500 kilocycles, I have found that by means of my invention I am able to substantially prevent the transmission of intermediate frequency to the amplifier tube in a receiver in which the circuits 10 and 11 are adjusted to an intermediate frequency as high as 450 kilocycles which is not far removed below the low frequency end of the broadcast range. In such a receiver I have found the following coupling values to be suitable:

Inductance of primary 1 equals 1.0 millihenry
Inductance of secondary 2 equals 0.2 millihenry
M equals 25 microhenries
Capacity of 3 equals 12 micromicrofarads
Maximum value of condenser 4 to tune over the broadcast range equals 400 micromicrofarads.

While I have shown a capacity coupling as being provided by a physical condenser 3 any other known means of providing this capacity coupling may be provided such, for example, as an open circuited turn of wire which is wound about the secondary coil 2 and connected by a lead to the high frequency end of primary coil 1

or any other preferred known means may be utilized to provide this capacity coupling.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. In a superheterodyne receiver, the combination of an input circuit including a radio frequency transformer having an untuned primary winding and a secondary winding, a single condenser having its opposite sides directly connected to the ends of said secondary winding to tune said secondary winding to the signal frequency, a source of signal energy connected to said primary winding and means for preventing energy of the intermediate frequency substantially lower than the signal frequency from passing through said secondary winding comprising a capacity coupling between said primary and secondary windings said capacity coupling being in opposed phase to the inductive coupling between said windings and the value of said capacity coupling being substantially less than the maximum value of said single condenser.

2. In combination, a radio frequency amplifier having an input circuit and an output circuit, said input circuit comprising a radio frequency transformer having an untuned primary and a secondary winding, a condenser shunted across said secondary winding to tune it to the signal frequency, an antenna directly connected to a point on said primary winding, a condenser having one side connected to the point of said primary winding to which said antenna is connected and its other side to one end of said secondary winding, said primary winding being so poled in relation to said secondary winding that the energy transferred by the inductive coupling therebetween is opposed to the energy transferred through said condenser and the capacity of said condenser being so related to the coupling between the primary and secondary windings that energy of an intermediate frequency lower than the signal frequency is not transmitted through said input circuit, and a first detector coupled to said output circuit.

3. In a superheterodyne receiver having a first detector whose output circuit is tuned to a desired intermediate frequency, the combination of a radio frequency amplifier having an output circuit coupled to the input circuit of said detector, and an input circuit comprising a transformer having an untuned primary winding and a secondary winding, the inductance of said primary being substantially greater than that of said secondary winding, a single condenser having its opposite sides directly connected to the ends of said secondary winding to tune said secondary winding to the signal frequency, means for impressing signal currents on said primary winding, a direct current connection between one end of said primary winding and ground, a capacity connecting said primary and secondary windings, the energy transferred by said capacity being opposed to that transferred by the inductive coupling between said windings and means for adjusting said capacity to such a value as to prevent energy of an intermediate frequency substantially lower than the signal frequency from passing to said detector input circuit.

4. In a superheterodyne receiver having a circuit tunable to an intermediate frequency, the combination of a receiver input circuit including a radio frequency transformer having an untuned primary and secondary windings, a condenser having its opposite sides directly connected to the ends of said secondary winding for tuning said secondary winding to a signal frequency substantially higher than said intermediate frequency, a source of signal energy connected to said primary winding and a capacity connected between said windings, the coupling between said windings and the value of said capacity being so related that

$$K=f\times 2\pi\sqrt{MC}$$

where

K=coefficient of coupling between primary and secondary windings,
f=intermediate frequency
M=mutual inductance between windings
C=capacity value

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