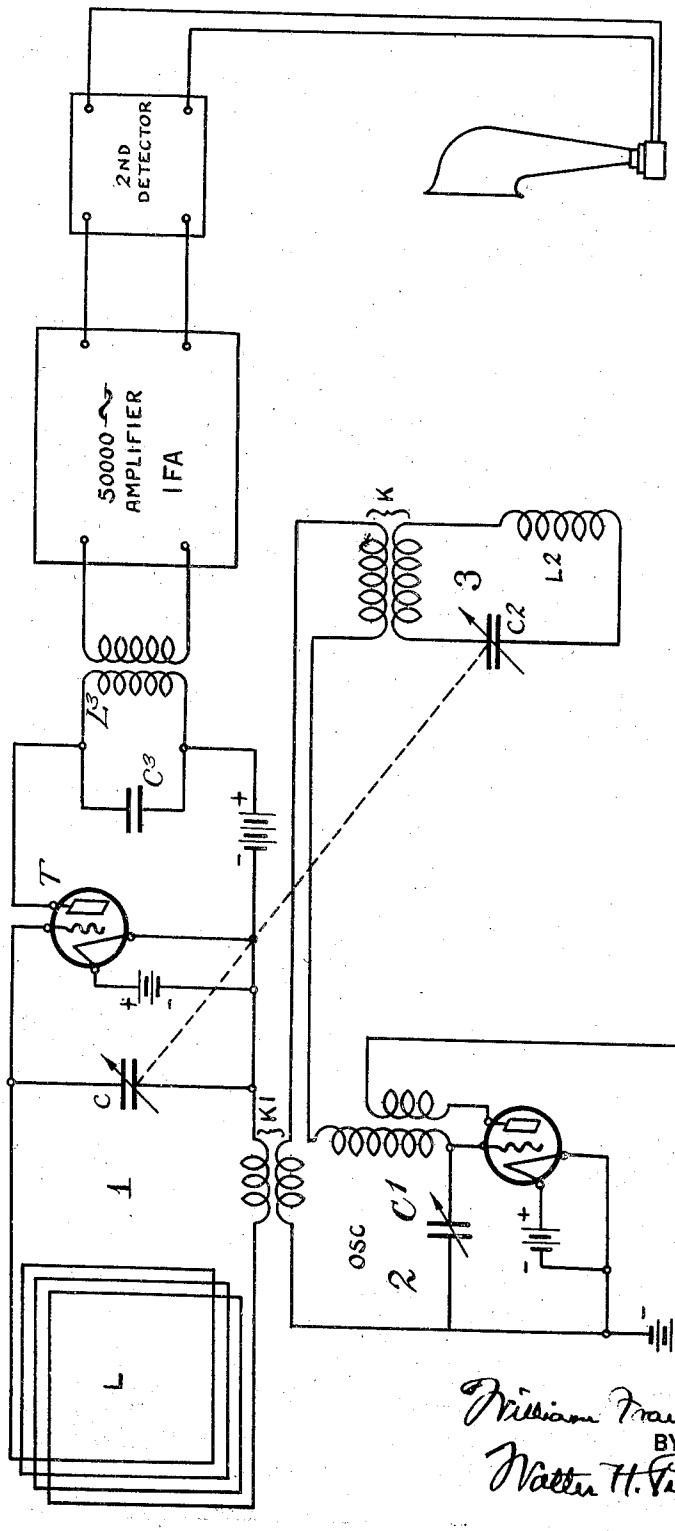
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RADIO RECEIVING APPARATUS

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RADIO RECEIVING APPARATUS.

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My invention relates to an improved arrangement of the so-called superheterodyne method of receiving. It is well understood that this system depends upon the production of a beat note, or, intermediate frequency, caused by the introduction of radio frequency currents having a frequency differing from that of the signal current, such difference being adjusted to equal the frequency for which the intermediate frequency amplifier is designed.

In the accompanying circuit diagram, circuit 1 represents the receiving circuit, ordinarily tuned for the incoming signal, and circuit 2 is the additional circuit which introduces into the receiving circuit the additional radio frequency current referred to above. Circuit 3 is an additional circuit, the function of which is to be described later.

Circuit 1 is made up of the loop antenna L in series with the coil of the coupler K^1 and the tuning condenser C. The circuit might, of course, use an antenna of the ordinary kind, but this will generally be undesirable.

Circuit 2 produces alternating currents of radio frequency by virtue of the action of the triode to which it is attached. The frequency of the current is generally controlled by the variable condenser C^1. Through the action of the coupler K^1, a current is set up in circuit 1 by circuit 2, having the frequency set by circuit 2 and an amplitude controlled by the amount of coupling in K^1.

This locally generated current in circuit 1, in combination with the signal current in circuit 1, acts in the triode T, to give in the plate circuit of this tube an intermediate frequency current. The plate circuit of this triode is tuned to the intermediate frequency by the coil and condenser L^3, C^3, and this circuit is coupled to the input of the intermediate frequency amplifier IFA, as shown in the accompanying diagram.

The frequency of this current supplied to the amplifier IFA, is equal to the difference in frequency of the signal current coming in the loop aerial L and that generated in circuit 2.

From what has been said, it will be realized that the same value of intermediate frequency will be obtained for two values of frequency in circuit 2. This circuit can be set to generate a frequency either higher or lower than the signal current and if the difference of this frequency and that of the signal current is that for which the intermediate frequency amplifier is built, equally good results will be obtained.

Hence it will be seen that there will be two settings of the condenser C^1, which will result in equally good reception of an antenna signal current. This is an objectional feature of receivers of this type, as it results in one signal frequency using up two settings of the adjustable condenser C^1, thus limiting the number of signal frequencies that can be received in the set without interference.

It is the object of this invention to overcome this difficulty by so improving the circuit that only one setting of C^1 can be found which will bring in a signal current of a certain frequency. Thus any one signal will be found at only one place on the dial of C^1.

In this improved system, a third circuit is added, which is coupled electrically to circuit 2, and mechanically to circuit 1. The electrical connection will generally be brought about by an inductive coupling and the mechanical connection will be brought about by putting the movable members of the condensers of circuit 1 and circuit 3 on the same shaft, or otherwise arranging them for simultaneous motion.

In the accompanying circuit diagram, the additional circuit is indicated by the number 3, and it is seen that this circuit consists of a coil L^2, condenser C^2, and one coil of the coupler K. The mechanical connection of C^2 and C is indicated by the dashed line connecting these two condensers. The electrical coupling between circuits 3 and 2 is by means of the coupler K.

To illustrate the operation of the system, we will suppose the signal to be received has a frequency of 1000 kilocycles. Further we suppose the intermediate frequency amplifier is properly designed to amplify a frequency of 50 kilocycles. Then the unimproved receiving set (not having additional circuit 3) would receive the signal of circuit 2 as set to oscillate at either 950 kilocycles or 1050 kilocycles. These two frequencies correspond to two different settings of condenser C^1.

Now we suppose circuit 3 is tuned to 1050 kilocycles and that it is suitably coupled to the oscillator circuit 2. This circuit 3 will introduce a high resistance into circuit 2 for that frequency to which circuit 3 is tuned, and if circuit 3 is properly designed, circuit 2 will not be able to oscillate at a

frequency of 1050 kilocycles. Thus with circuit 1 tuned for 1000 kilocycles and circuit 3 tuned for 1050 kilocycles, a signal will be supplied to the intermediate frequency amplifier only when circuit 2 is adjusted for 950 kilocycles. For if the oscillator circuit is adjusted for 1050 kilocycles (which frequency should also give a difference in frequency of 50 kilocycles), the action of circuit 3 prevents circuit 2 from oscillating and thus no intermediate frequency current is produced. Hence the 1000 kilocycles signal is heard at only one setting of the oscillator circuit condenser, namely that for which the oscillator generates 950 kilocycles.

In case it is desired to receive the 1000 kilocycle signal with the oscillator set to generate 1050 kilocycles, then circuit 3 would be tuned to 950 kilocycles so that the oscillator could not oscillate at this frequency when circuit 1 was tuned to 1000 kilocycles. Here also the 1000 kilocycles signal would be received at only one adjustment of the condenser C^1.

It will be appreciated that the specific values of frequencies given above are merely illustrative and that the circuit when properly arranged will work in the same manner for any other frequency.

Thus suppose it is desired to receive an 800 kilocycle signal and that the oscillator circuit is to bring in the desired signals only when its frequency is lower than that of the signal. As the intermediate frequency amplifier again requires a 50 kilocycle current, the oscillator must be set for 750 kilocycles to bring in the signal. Then in my improved system, the oscillator circuit must not function for 850 kilocycles and to bring this about the additional circuit 3 must now be tuned to 850 kilocycles. It will then introduce a large resistance into the circuit 2 at that frequency so that the oscillations in circuit 2 can not be maintained by the triode.

To bring about the effect described above, it is seen that circuit 3 must be maintained tuned to a frequency either higher or lower than the signal frequency (to which circuit 1 is tuned) by an amount equal to the frequency of the intermediate frequency amplifier. To bring about this required frequency relation between circuits 1 and 3, the two condensers C and C^2 should preferably be mounted on the same shaft and be of the straight line frequency type.

In this system when variable condensers C and C^2 are mechanically connected, the most desirable method of maintaining the constant frequency difference required for the purpose of this invention is to use variable condensers of such design that a constant frequency increase is obtained for a given movement of the dial, through all parts of its range. These condensers are generally referred to as straight line frequency condensers. It should be understood, however, that the two condensers need not be of the same kind nor of the straight line frequency type provided that the design of each with respect to the other is such that the circuits with which they are connected will always have a constant frequency difference. Furthermore, two ordinary condensers may be used and connected to a common control knob dial by means of a system of suitably shaped cams in substitution for the straight line frequency type of variable condenser.

Having thus described my invention, what I claim is:

1. In a signal responsive system employing a pick-up circuit, an oscillator circuit, an intermediate frequency amplifier, and means for producing a frequency selective impedance, the method of eliminating an undesired frequency responsive condition which consists in introducing into the oscillator circuit the frequency selective impedance, said frequency selective impedance being so conditioned that its maximum value is maintained at a frequency other than that at which the oscillator is designed to operate for the desired signal and differing from that of the pick-up circuit by an amount equal to that for which the intermediate frequency amplifier is tuned.

2. In a signal responsive system employing a pick-up circuit, an oscillator circuit, an absorbing circuit, and an output circuit, associated in cooperative relation, the method of eliminating an undesired signal responsive condition which consists in coupling the absorbing circuit to the oscillator circuit and maintaining the tuning of the absorbing circuit, throughout the frequency range of the system, to a frequency other than that at which the oscillator circuit is designed to operate for the desired signal and differing from that of the pick-up circuit by an amount equal to the frequency difference of the oscillator and pick-up circuits.

3. In a signal responsive system employing a pick-up circuit, an oscillator circuit, an absorbing circuit, and an output circuit, associated in cooperative relation, the method of eliminating an undesired signal responsive condition which consists in directly coupling the absorbing circuit to the oscillator circuit, and simultaneously tuning the pick-up circuit and absorbing circuit, throughout the frequency range of the system, to a frequency other than that at which the oscillator circuit is designed to operate for the desired signal and differing from that of the pick-up circuit by an amount equal to the frequency difference of the oscillator and pick-up circuits.

4. In a signal responsive system, a receiving circuit for the incoming electric wave, a

second circuit adapted to be tuned to a frequency differing from the frequency of the first circuit, a third cooperating circuit, and means for simultaneously tuning the first and third circuits so as to maintain the third circuit, throughout the frequency range of the system, tuned to a frequency other than that at which the second circuit is designed to operate for the desired signal and differing from that of the first circuit by an amount equal to the frequency difference between the first and second circuits.

5. In a signal responsive system, a receiving circuit for the incoming electric wave, a second circuit adapted to be tuned to a frequency differing from the frequency of the first circuit, and a third circuit having a variable tuning element mechanically connected in such relation to a variable tuning element of the first circuit as to maintain the third circuit, throughout the frequency range of the system, tuned to a frequency other than that at which the second circuit is designed to operate for the desired signal and differing from that of the first circuit by an amount equal to the frequency difference between the first and second circuits.

6. In a signal responsive system, a receiving circuit for the incoming electric wave, a second circuit adapted to be tuned to a frequency differing from the frequency of the first circuit, a third cooperating circuit, and mechanically connected means operable by a single control for simultaneously tuning the first and third circuits so as to maintain the third circuit, through the frequency range of the system, tuned to a frequency other than that at which the second circuit is designed to operate for the desired signal and differing from that of the first circuit by an amount equal to the frequency difference between the first and second circuits.

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