

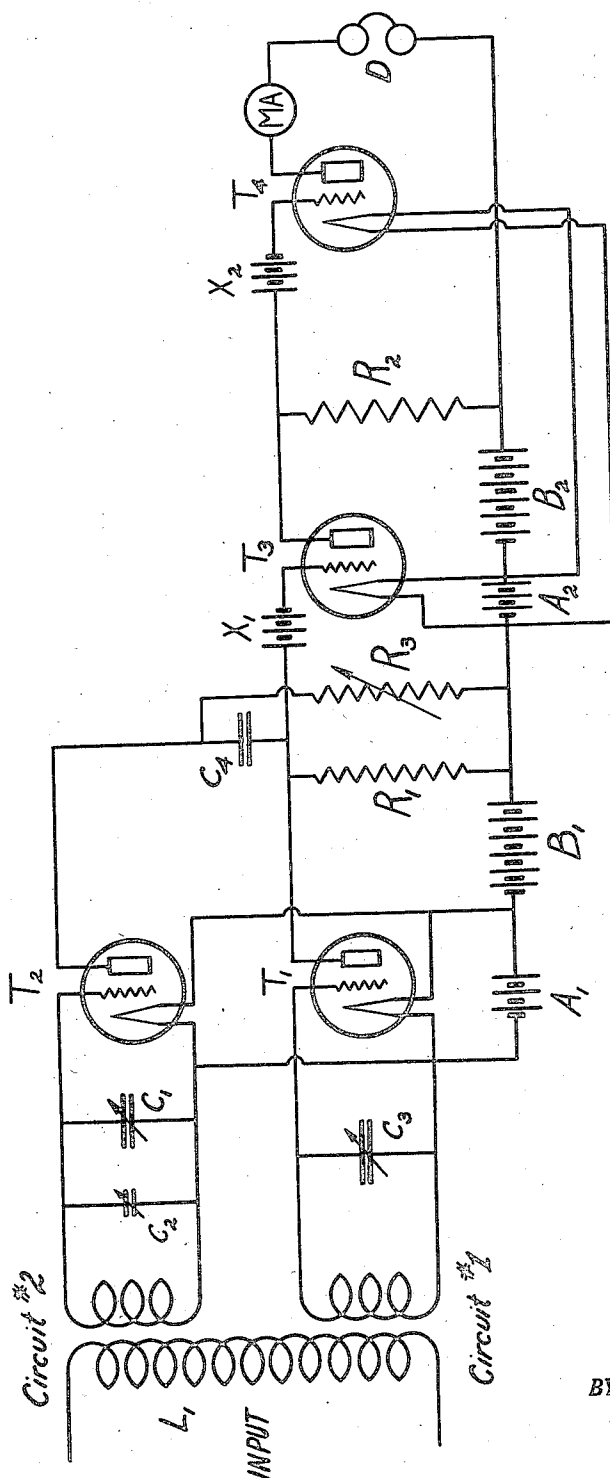
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STATIC AND INTERFERENCE BALANCE SYSTEM

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STATIC AND INTERFERENCE BALANCE
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My invention relates broadly to signal receiving systems and more particularly to a static and interference balance circuit for signal receiving systems.

One of the objects of my invention is to provide a static and interference balance circuit particularly adapted for radio broadcast sound and television receiver operation.

Another object of my invention is to provide a static and interference balance circuit which may be employed in superheterodyne receiving circuits for broadcast reception.

A further object of my invention is to provide a circuit arrangement for a static and interference balance circuit employing an electron tube system having a pair of branches maintained in an inphase relation for controlling the transfer of desired signaling energy to a signal observing circuit independent of static and interfering signals.

A still further object of my invention is to provide a method for selectively receiving desired signaling energy independent of interfering signaling energy wherein an electron tube circuit is rendered responsive to the desired signaling energy while discriminating against the undesired signals.

Other and further objects of my invention reside in a circuit arrangement for controlling the bias upon the control grid of an electron tube circuit for rendering the tube circuit responsive to desired signaling energy while discriminating against undesired signaling energy as set forth more fully in the specification hereinafter following by reference to the accompanying drawing which diagrammatically illustrates my invention.

The circuit of my invention has been successfully employed for the elimination of undesired signals and strays, or static. This is accomplished by splitting the incoming energy into two parts in circuits #1 and #2 and allowing the circuits to energize the grids of two vacuum tubes T₁ and T₂. The grid circuit of tube T₁ is made resonant to the frequency or wavelength of the incoming energy. The grid of tube T₁, in circuit #1, will then be actuated by both the desired and undesired energy. Plate current changes will therefore take place through tube T₁, and a voltage will be produced across resistance element R₁ which will be impressed on the grid of amplifier tube T₃. The other circuit, that is circuit #2, will be resonant to a frequency differing from the frequency or wavelength of the incoming energy by an amount equal to the fre-

quency band it is desired that circuit #1 pass. Hence when this balance system is used in a broadcast receiving circuit, circuit #2 will differ from circuit #1 in wavelength by plus or minus eight to ten kilocycles, while in a radio receiver used for code work, circuits #1 and #2 will differ by only a few kilocycles. The grid of tube T₂ in circuit #2 will then be actuated by only the interfering energy, which, if circuit connections are proper, will be inphase with the energy in circuit #1. The undesired energy will set up a voltage across adjustable resistance element R₃, which can be adjusted to produce a voltage across condenser C₄, on the grid of tube T₃, equal to that voltage produced by the undesired energy from tube T₁ and resistance element R₁. This voltage will tend to increase in a positive direction the average grid voltage of tube T₃, further tending to increase the plate current through this tube. The output of amplifier tube T₃ is connected to detector tube T₄ which has indicating or recording means in the output thereof.

From inspection of the circuits of tubes T₁ and T₃ it will be found that the grid of tube T₃ is so connected to the plate circuit of tube T₁ that the voltage produced across resistance element R₁, due to an increase of plate current through tube T₁ which is the result of the desired and undesired voltages being impressed on the grid of T₁, will be negative insofar as the grid of tube T₃ is concerned. A source of normal bias potential X₁ is provided for tube T₃. This negative voltage, consisting of desired and undesired energy, will tend to decrease the average grid voltage of tube T₃, decreasing the plate current through tube T₃. The voltage across condenser C₄, consisting of undesired energy alone, will be positive in so far as the grid of tube T₃ is concerned and will tend to increase the current through tube T₃. By a proper adjustment of resistance element R₃ the voltage of the undesired energy from tube T₂ can be made to equal the voltage of the undesired energy from tube T₁. When this adjustment has been attained, the resultant change of plate current through tube T₃ due to the undesired energy will be zero, in so far as interference is concerned while the desired energy from tube T₁, meeting no counter voltage from tube T₂, will operate the grid of tube T₃ and the concomitant plate current variations will consist of desired energy alone, indicating that all interfering voltages have been balanced out and their effects eliminated. The desired energy alone will be permitted to cause a change of voltage across resistance element R₂.

If the grid of tube T_4 were so adjusted that a change of plate current would take place regardless of whether the voltage across resistance element R_2 was increased or decreased it would be difficult to determine when a balance of undesired and desired energy on the grid of tube T_3 had been obtained. Because the desired energy decreases the grid voltage and plate current of tube T_3 , thereby causing a fall of voltage across resistance element R_2 , it is necessary that a tube follow tube T_3 and be so adjusted that it will pass plate current only when the voltage across resistance element R_2 decreases. If plate current were allowed to pass through this tube when the current through resistance element R_2 increased, any excess of counterbalancing undesired energy would be allowed to operate tube T_4 , the output of which includes the responsive device such as telephones D_1 or relay device leading to a facsimile or printer recorder. This condition would be undesirable and would defeat in part the object of this circuit.

The source of bias potential X_2 for tube T_4 is so adjusted that plate current through tube T_4 , registered by meter MA is zero. In this condition when the voltage across resistance element R_2 decreases below its average value, tube T_4 will pass the desired signal. The function of resistance element R_2 and tube T_4 is, then, twofold: (A) Prevention of the output being further disturbed by undesired energy, and (B) complete rectification or detection of the desired signal. Tube T_4 may be followed by suitable audio amplification to bring the desired signal up to a sufficient level.

The circuit of my invention is particularly adaptable to the double detector or super-heterodyne type of receiver though it is applicable to any type. The input inductance L_1 then becomes the output coil in the plate circuit of the last intermediate amplifier tube. The condensers C_1 , C_2 , and C_3 can then be set to accommodate the intermediate or beat frequency. Condenser C_2 may be of midget size and be variable for further micrometer adjustment to eliminate interfering side bands. Condenser C_2 should be large enough to bring circuit #2 in resonance with circuit #1 so that the width of the frequency band passed through circuit #1 can be adjusted to suit local conditions.

The sources of potential may be obtained from batteries, generators or from the usual lighting circuit. For convenience I have illustrated batteries in the circuit but any source of supply may be employed. Sources B_1 and B_2 may be separate supplies. Likewise, filament sources A_1 and A_2 may be separate supplies.

The circuit of my invention is particularly adaptable for operation from a power pack unit having two filaments, two plates and two bias supplies for the separate circuits 1 and 2. A number of alternative methods may be employed for the coupling condenser C_4 and a resistance R_3 . The method of coupling shown provides an efficient form of amplification control for the circuit 2 which is the interference balance circuit. Precision adjustment is provided in each of the circuits in order that a fine balance may be obtained for the reception of signals through undesired static conditions. The circuit arrangement has a broad application in the field of facsimile for machine transmission wherein interference from static is highly detrimental. I have operated the circuit arrangement of my invention in connection with automatic printers in

radio with substantial success even during heavy static conditions. It will be observed that the pair of circuits 1 and 2 are maintained in phase. The power factor of the two circuits should be equal and should be one hundred per cent. Where the in-phase relationship may be shifted due to faulty construction, compensation may be made by an alternative form of coupling in place of the resistance R_3 and condenser C_4 . The circuit arrangement of my invention has been found to be highly practical and successful in its operation.

I have explained the principles of my invention in connection with the circuit arrangement illustrated, but I desire that it be understood that the circuit is to be considered in the illustrative sense and that modifications of the system of my invention may be made and that I intend no limitations upon my invention other than are imposed by the scope of the appended claims.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalty thereon or therefor.

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. A static and interference balance circuit, comprising in combination with a radio frequency system including a transformer having an input primary winding connected to the output of the intermediate frequency amplifier of a super-heterodyne radio receiving system and a pair of output secondary windings, an electron tube circuit connected with one of said secondary windings tuned to pass the desired and undesired signal energy, a second electron tube circuit connected with the other of said secondary windings tuned to pass only the undesired signal energy, said electron tube circuits having unity power factor, a signal amplifier, an electron tube detector connected in the output circuit of said amplifier, and means coupling the output circuits of said aforementioned electron tube circuits in opposition to the input circuit of said amplifier.

2. A static and interference balance circuit, comprising a radio frequency system connected to the output of the radio frequency amplifier of a radio receiving system, an input circuit having a pair of separate branch circuits, an electron tube connected in each of said branch circuits, tuning means resonant to the frequency of the incoming signaling energy connected with one of the branch circuits, tuning means connected with the other of said branch circuits and resonant to a frequency differing from the frequency of the aforesaid branch circuit, a resistance element connected in the output circuit of each of said electron tubes, an electron tube amplifier, a signal detector connected with the output of said amplifier, a connection between one side of the input circuit of said amplifier and each of said resistance elements in common, a condenser connected between the other ends of said resistance elements and a connection between one side of said condenser and the other side of the input circuit of said amplifier.

3. A static and interference balance circuit comprising an input system having a primary winding constituting part of the output circuit of the intermediate frequency amplifier of a super-heterodyne radio receiving system and a pair of secondary windings, an electron tube circuit connected with each of said secondary windings,

means for tuning each of said secondary windings over different frequency bands whereby one of said electron tube circuits is resonant to a frequency dependent upon the frequency of the incoming desired signaling energy and the other of said electron tube circuits is resonant to a frequency differing from the frequency of the aforesaid circuit by an amount equal to the amplitude of the frequency band that said first mentioned electron tube circuit will pass, a resistance element individual to the output circuit of each of said electron tube circuits, a biased grid electron tube circuit having input terminals and output terminals, connections between one of said input terminals and the ends of said resistance elements connected in common, a direct connection between the other of said input terminals and the opposite end of one of said resistance elements, a capacitative connection to the opposite end of the other of said resistance elements, and signal receiving means connected across the output terminals of said biased electron tube circuit.

4. A static and interference balance circuit comprising an input system forming part of the output of the intermediate frequency amplifier of a superheterodyne radio receiving system and including a pair of branch circuits, an electron tube connected in each of said branch circuits, means for tuning the input of one of said electron tubes to a frequency dependent upon the frequency of the incoming desired signaling energy, an impedance in the output circuit of said last mentioned electron tube through which current increases according to the amplitude of both desired and undesired signaling energy, means for tuning the input of the other of said electron tubes to the frequency of the undesired energy, an impedance in the output circuit of said last mentioned electron tube responsive to current due to undesired energy, a conductive connection between adjacent ends of said impedances, a capacitative connection between opposite ends of said impedances, and an electron tube circuit having a signal detecting device in its output system, said electron tube circuit connected across one of said impedances.

5. A static interference and balance circuit comprising an input winding forming part of the output of the intermediate frequency amplifier of a superheterodyne radio receiving system and a pair of output windings, independent means for tuning each of said windings, an electron tube individual to each of said means, the tuning means connected with one of said windings being resonant to a frequency dependent upon the frequency of the incoming desired signaling energy and the tuning means connected with the other of said windings being resonant to a frequency differing from the frequency of the first mentioned tuning means by an amount within the frequency band that the first mentioned tuning means will pass, an impedance in the output circuit of each of said electron tubes, a common connection between adjacent ends of each of said impedances, a capacitative connection between the opposite ends of said impedances, an electron tube amplifier, a signal detector connected in the output of said amplifier, and connections between the input circuit of said amplifier and the terminals of the impedance in the output of the electron tube which connects to the circuit resonant to the frequency dependent upon the frequency of the incoming signaling energy.

6. In a static and interference balance circuit, an input system including a primary winding

forming part of the output of the intermediate frequency amplifier of a superheterodyne radio receiving system and a pair of secondary windings, tuning means individual to each of said windings, an electron tube connected with each of said tuning means, the tuning means connected with one of said windings being resonant to a frequency dependent upon the frequency of the incoming desired signaling energy and the tuning means connected with the other of said windings being resonant to a frequency differing from the frequency of the aforesaid tuning means by an amount equal to the frequency band that the first mentioned tuning means will pass, a source of potential, a resistance element completing the connection between said source of potential and the output circuit of one of said electron tubes, an independent resistance element completing the connection of said source of potential with the output circuit of the other of said electron tubes, a condenser interconnecting the ends of said resistance elements remote from said source of potential, an electron tube circuit having a normally biased grid, a signal detector connected with said normally biased electron tube circuit, and connections between said resistance elements and said normally biased electron tube circuit for controlling the operation of said normally biased electron tube circuit and actuating said signal detector in accordance with the incoming signaling frequencies to the substantial exclusion of undesired frequencies and static.

7. In a static and interference balance circuit, an input system including a primary winding forming part of the output of the intermediate frequency amplifier of a superheterodyne radio receiving system and a pair of secondary windings, tuning means individual to each of said windings, an electron tube connected with each of said tuning means, the tuning means connected with one of said windings being resonant to a frequency dependent upon the frequency of the incoming desired signaling energy and the tuning means connected with the other of said windings being resonant to a frequency differing from the frequency of said first mentioned tuning means by an amount equal to the frequency band that the first mentioned tuning means will pass, a source of potential, a resistance element completing the connection between said source of potential and the output circuit of one of said electron tubes, an independent resistance element completing the connection of said source of potential with the output circuit of the other of said electron tubes, a condenser interconnecting the ends of said resistance elements remote from said source of potential, an electron tube circuit having a normally biased grid, the input of said electron tube circuit connected across one of said resistance elements, a resistance element disposed in the output circuit of said last mentioned electron tube circuit and operative to produce a variation in potential under the coaction of potentials established across the aforementioned resistance elements in accordance with desired signaling energy and to the exclusion of undesired signaling energy and static, and a signal detector connected across the terminals of said last mentioned resistance element.

8. In a static and interference balance system in connection with an output circuit carrying desired and undesired signal energy at constant frequencies, a plurality of parallel circuits cou-

pled to said output circuit, one of said parallel circuits tuned to the desired signal frequency and passing undesired signal frequencies, another of said parallel circuits tuned to the frequency of a signal interfering with the desired signal, an electron tube circuit having an input circuit, the output of the circuit containing desired and undesired currents connected to said input circuit for effecting a decrease in the current through said electron tube, the output of the circuit containing mainly the undesired currents connected to said input circuit for effecting an increase in the current through said electron tube in proportion to and in phase opposition to the undesired components in said first mentioned parallel circuit, the output of said electron tube circuit connected to an electron tube detecting circuit arranged for operation only when the current in the input circuit thereof and, therefore, the voltage on the grid thereof decreases, said arrangement preventing interference from an excess of counterbalancing undesired energy and effecting complete rectification of the desired signal energy.

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