

June 17, 1947.

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2,422,374

RADIO RECEPTION MEANS

Filed Feb. 16, 1943

2 Sheets-Sheet 1

Fig. 1.

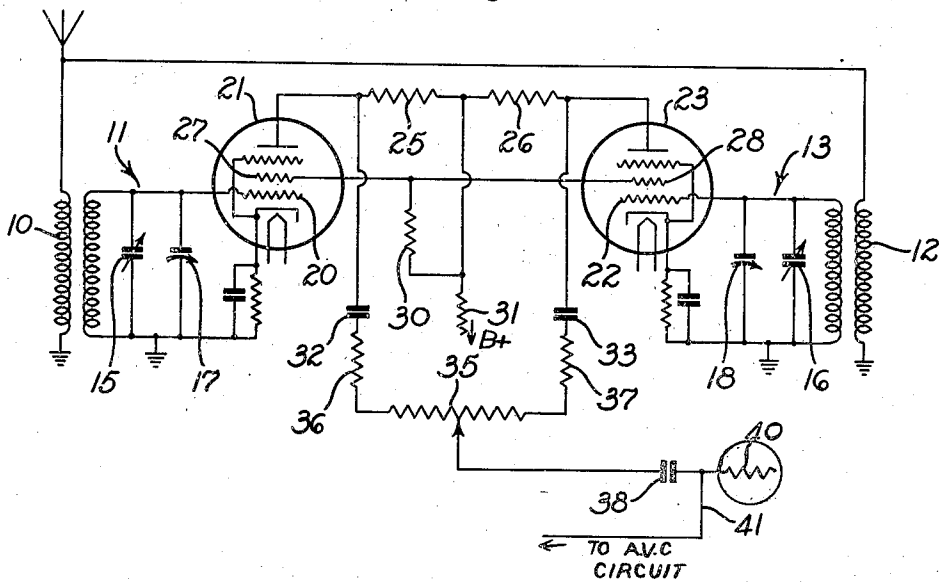
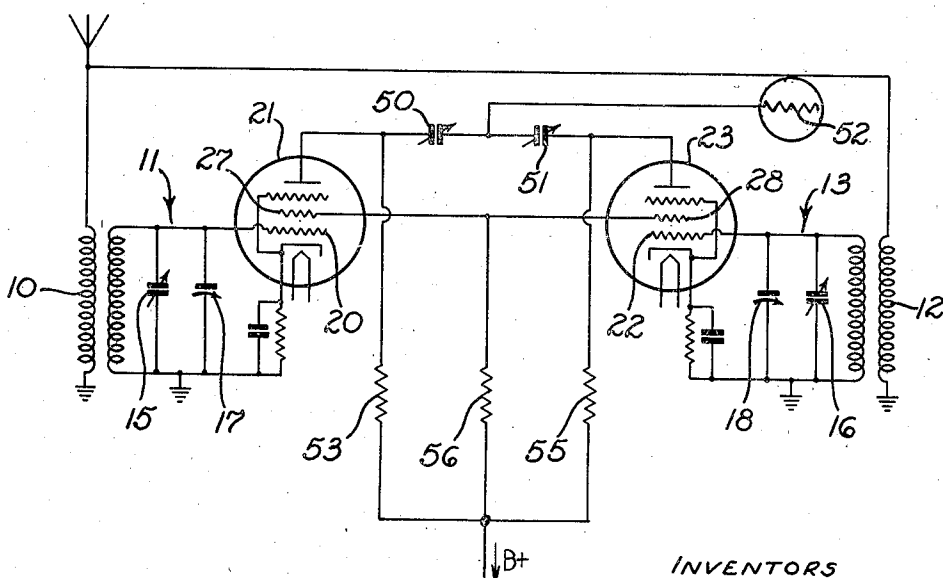


Fig. 2.



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Fig. 3.

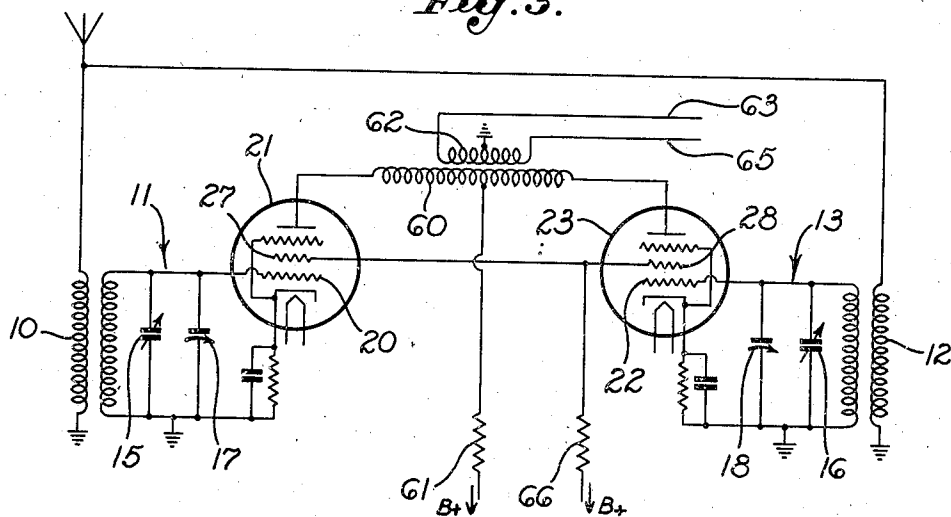
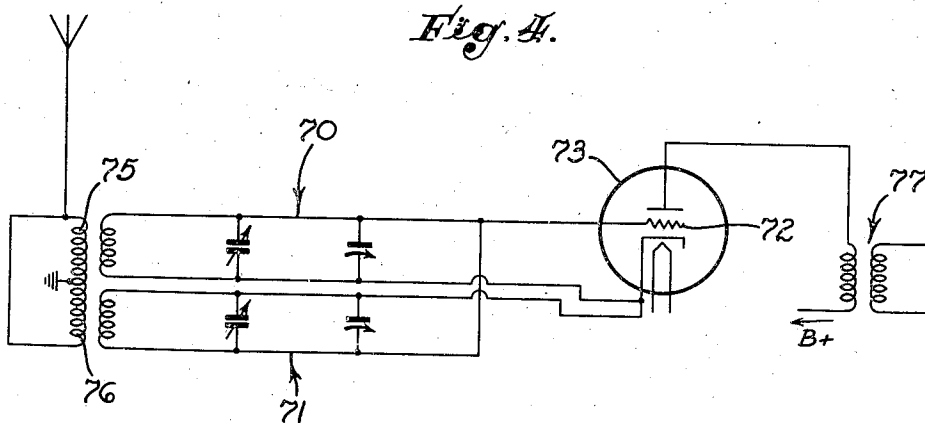


Fig. 4.



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RADIO RECEPTION MEANS

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6 Claims. (Cl. 250—20)

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Our invention relates to radio receivers and is directed particularly to a radio receiver designed to minimize interference with desired signals.

The general object of our invention is to provide a means and method for greatly reducing, if not entirely eliminating, extraneous aperiodic waves in radio reception with little or no resultant reduction of the desired signal wave. It is a further object of our invention to provide means to reduce or preclude static that is both relatively simple and relatively inexpensive. In some practices of our invention one of our purposes is to provide such static-eliminating means that may be readily incorporated in existing conventional receivers.

The objects and advantages of our invention will be readily apparent in the following description, taken with the accompanying drawing.

In the drawing, which is to be considered as illustrative only:

Fig. 1 is a wiring diagram illustrating one practice of our invention in which two vacuum tubes are used;

Figs. 2 and 3 illustrate modifications of the wiring diagram of Fig. 1; and

Fig. 4 is a wiring diagram illustrating a second practice of our invention involving the use of only one tube.

In Fig. 1 the antenna circuit has two grounded coils in parallel, namely, a first coil 10 for coupling to a first tuning circuit 11 and a second coil 12 for coupling to a second tuning circuit 13. The resonant frequency of the first circuit 11 may be controlled by the usual tuning condenser 15, and in like manner the second tuning circuit 13 may be controlled by a tuning condenser 16.

Our invention is based on the concept of tuning one of these circuits for optimum reception of a given signal, detuning the other circuit slightly with respect to the frequency of such signal to reduce by a substantial amount the signal voltage in the circuit, interrelating the two circuits in a voltage-opposing relation, and transferring the resulting net voltage to the next stage in the receiver. In putting this conception into practice, it is found that the two circuits may be so tuned relative to each other and relative to a given signal that aperiodic waves affect both circuits with substantially equal or comparable voltages while the desired amplitude-modulated signal wave produces substantial signal voltages in the tuned circuit but little or no signal voltages in the detuned circuit whereby the signal voltage is substantially eliminated in the detuned circuit. Since the two circuits are in voltage-opposing

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relation to each other, it may be readily understood that the interference voltages are substantially cancelled, whereas relatively little cancellation of the signal voltage occurs. The net result, then, is the considerable reduction of the instant interference voltage relative to the instant signal voltage delivered by the joint tuning circuits.

The two variable condensers 15 and 16 may be the sole means for varying the resonant frequencies of the two circuits 11 and 13, and these two variable condensers may be operable independently. In the preferred practice of our invention, however, we insert what may be termed a padding condenser or a trimming condenser in at least one of the two circuits to be relied upon primarily for tuning differentiation, and we further prefer to interconnect the two tuning condensers 15 and 16 for joint manipulation. In the particular arrangement illustrated by Fig. 1, we place a padding condenser 17 in the first tuning circuit 11 and likewise place a similar padding condenser 18 in the second tuning circuit 13. At least one of the two padding condensers 17 and 18 may be manually adjustable by the usual screw arrangement.

For the purpose of interrelating the two tuning circuits 11 and 13 and for connecting them in voltage-opposing relation, we connect the first receiving circuit 11 to a grid 20 in a first vacuum tube 21 and connect the second tuning circuit 13 to a grid 22 in a second vacuum tube 23.

In the preferred practice of our invention involving the use of two such vacuum tubes, we employ a resistance coupling in relating the two tubes to each other. Thus, Fig. 1 shows the plates of the tubes 21 and 23 interconnected by two resistances 25 and 26 in series. A screen grid 27 in the tube 21 and a screen grid 28 in the tube 23 are connected to each other and to one end of a resistance 30. The other end of the resistance 30 is connected to the resistances 25 and 26 at the juncture of these resistances and is also connected to one end of a resistance 31 leading to the positive side of the "B" voltage supply. The two resistances 25 and 26 place equal voltages on the plates of the two tubes while the resistances 30 and 31 regulate the plate and screen voltages.

The new voltages from the two tuning circuits are transferred to the next stage through a balancing network having the following elements: a condenser 32 connected to the plate of the tube 21, a condenser 33 connected to the plate of the

tube 23, a voltage divider 35, a resistance 36 connecting the condenser 32 to the voltage divider, and a resistance 37 connecting the condenser 33 to the voltage divider. Fig. 1 shows the adjustable contact of the voltage divider connected through a condenser 38 to the grid 40 in the next succeeding stage of the receiver. After proper balance is attained subsequent adjustment is unnecessary and the contact of the voltage divider may be permanently set. If desired, automatic volume control may be connected into the circuit as indicated by the wire 41 without impeding operation in any manner.

In the described balancing network, the two condensers 32 and 33 cut off direct current and the voltage divider 35 serves the dual function, first, of providing adjustable means for balancing the arrangement, and, second, of providing means for taking off uncanceled voltages for transfer to the next stage in the receiver.

In practice, the first circuit 11 may be tuned sharply to a desired signal and the second circuit 13 tuned away from the signal sufficiently to obtain the desired result. The proper relationship between the two circuits may be quickly found by trial and error even by an operator who has had no opportunity to practice with the invention.

One feature of the described arrangement is that only one antenna is employed, instead of two antennas required for some systems of static elimination heretofore proposed. Another feature is that various types of tubes may be used successfully, including triodes and tetrodes, as well as pentodes. Another feature is that if the invention is embodied in a unit separate from the receiver, the tube normally used as the first R. F. tube can be dispensed with and the output of the unit fed into the grid of the mixer stage. Of course, with respect to a designed unit, the silencer takes the place of the first R. F. stage.

Figs. 2 and 3 are largely identical with Fig. 1, corresponding numerals being employed to indicate corresponding parts. The purpose of these two figures is to indicate how the circuit arrangement of Fig. 1 may be modified by employing impedance coupling instead of resistance coupling for interrelating the two tubes 21 and 23.

In Fig. 2 the plates of the tubes 21 and 23 are connected by two variable condensers 50 and 51 placed in series, and the grid 52 of the next stage is connected between the two condensers. The plate of the tube 21 is directly connected to the positive side of the "B" voltage supply through a resistance 53, and the plate of the tube 23 is likewise so connected through a resistance 55. The screen grids 27 and 28 of the two tubes are connected together and also connected to one end of a resistance 56 leading to the positive side of the "B" voltage supply. The variable condensers 50 and 51 serve as adjustable means for balancing the two sides of the general circuit for the desired effect.

In the arrangement illustrated by Fig. 3, the plates of the two tubes 21 and 23 are interconnected by a primary coil 60 which is connected by a center tap to a resistance 61 leading to the positive side of the "B" voltage supply. A secondary coil 62, the center turn of which is grounded, is inductively coupled to the primary coil 60 and may be connected by wires 63 and 65 to the posts of the usual fixed input impedance for transference of the uncanceled voltage to the next stage. The screen grids 27 and 28 are interconnected and are also connected to a resistance

66 leading to the positive side of the "B" voltage supply.

In the second form of our invention represented by Fig. 4, two tuning circuits 70 and 71 are both connected to the control grid 72 of a vacuum tube 73 in such manner that the two circuits affect the control grid with voltages of opposite phase in response to antenna voltages. Various circuit arrangements may be employed to achieve the desired 180° shift in voltage. In the present arrangement, for example, the antenna circuit has two oppositely wound primary coils 75 and 76 coupled respectively to the tuning circuits 70 and 71 so that an impulse of current in the antenna circuit creates positive voltage in one of the tuning circuits and negative voltage in the other tuning circuit. The plate circuit of the tube 73 includes the primary side of a coupling transformer 77 for transferring the uncanceled signal voltage to the next stage.

The particular circuits chosen to illustrate our invention and to disclose the principles involved will suggest to those skilled in the art various changes and substitutions under our basic concept, and we reserve the right to all such departures from our description that lie within the scope of our appended claims.

We claim as our invention:

1. A radio receiver having: a first vacuum tube having a grid; a second vacuum tube having a grid; a first receiving circuit connected to the grid of said first tube; a second receiving circuit connected to the grid of said second tube, said two receiving circuits receiving the same signal voltage and the same signal-interference voltage, said two circuits being tuned to sufficiently different frequencies to at least substantially reduce in one circuit the voltage of the signal to which the other circuit is tuned without precluding substantially equal signal-interference voltages in both of said circuits; an impedance means capacitively connected to the plate circuits of said two tubes to cause mutual voltage cancellation between the two tubes; and output means coupled with said two plate circuits to receive therefrom uncanceled voltages.

2. In combination in a radio receiver: a pair of input circuits connected to receive the same signal voltage and the same signal-interference voltage but differentially tuned so that one input circuit is tuned to the signal and the other is detuned sufficiently to substantially eliminate the signal voltage therein without largely reducing the signal-interference voltage common to the two circuits; electron tube means comprising two anodes, and two control grids for respectively controlling electron flow to said anodes, said grids being respectively connected to said input circuits; means for supplying substantially identical anode potentials to said anodes; and means for opposing the voltage outputs of said anodes and for creating an output signal substantially free of signal-interference voltages, said means including a voltage-dividing output resistance means providing end terminals and an intermediate terminal for taking off the output signal and a pair of condensers respectively connecting said anodes to said end terminals to insure the exclusive presence of alternating currents in said output resistance means.

3. In combination in a radio receiver: a pair of input circuits connected to receive the same signal voltage and the same signal-interference voltage but differentially tuned so that one input circuit is tuned to the signal and the other is

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de-tuned sufficiently to substantially eliminate the signal voltage therein without largely reducing the signal-interference voltage common to the two circuits; electron tube means comprising two anodes, and two control grids for respectively controlling electron flow to said anodes, said grids being respectively connected to said input circuits; impedance means connected between said anodes and providing an intermediate connection substantially electrically centered with respect to said anodes and adapted for connection to a source of anode potential to supply substantially equal potentials to said anodes; a voltage-dividing output resistance means providing end terminals and an intermediate output terminal; and a pair of condensers respectively connecting said anodes to said end terminals to insure the exclusive presence of alternating currents in said output resistance means.

4. In combination: electron tube means comprising two anodes, and two control grids for respectively controlling electron flow to said anodes; a pair of tuned input circuits respectively connected to said control grids; means for changing the tuning of one input circuit with respect to the other; impedance means connected between said anodes and providing an intermediate connection substantially electrically centered with respect to said anodes and adapted for connection to a source of anode potential to supply substantially equal potentials to said anodes; a voltage-dividing output resistance means providing end terminals and an intermediate output terminal; and means for connecting said end terminals of said output resistance means respectively to said anodes.

5. In combination in a radio receiver: a split antenna circuit providing two branches connected in parallel with each other; a pair of input circuits respectively coupled with said branches of said antenna circuit to receive the same signal voltage and the same signal-interference voltage but differentially tuned so that one input circuit is tuned to the signal and the other is de-tuned sufficiently to substantially eliminate the signal voltage therein without largely reducing the signal-interference voltage common to the two input circuits; first and second screen-grid vacuum tubes providing two anodes, two screen grids, and two control grids; means for respectively connecting said control grids to said input circuits; means for interconnecting said screen grids; and means interconnecting said anodes for opposing the potentials of said anodes to substantially cancel said signal-interference voltage and provide

an output voltage varying with the signal voltage.

6. In combination in a radio receiver: a pair of input circuits connected to receive the same signal voltage and the same signal-interference voltage but differentially tuned so that one input circuit is tuned to the signal and the other is de-tuned sufficiently to substantially eliminate the signal voltage therein without largely reducing the signal-interference voltage common to the two circuits; electron tube means comprising two anodes, and two control grids for respectively controlling electron flow to said anodes, said grids being respectively connected to said input circuits; resistance means including two substantially identical resistor sections providing two end terminals connected respectively to said anodes and interconnected for connection to a source of anode potential whereby substantially equal potentials are supplied to said anodes; a voltage-dividing output resistor providing end terminals and providing a circuit-balancing adjustable output contact; and a pair of condensers respectively connecting said anodes to said end terminals of said voltage-dividing output resistor to insure the exclusive presence of alternating currents in said output resistor.

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