

APERIODIC RECEIVER

OPERATING INSTRUCTIONS

SERIES K

Manufactured for

RADIO INTELLIGENCE DIVISION
ENGINEERING DEPARTMENT
FEDERAL COMMUNICATIONS COMMISSION

by

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APPLICATION

The Aperiodic Receiver is a device suitable for intercepting radio signals within the frequency range of approximately 50 kc. to 60 mc. when the signal input to the receiver exceeds 10 millivolts.

This receiver is unusual as compared to other types of radio receivers in that no tuning is required. The Aperiodic receiver is therefore suitable for detecting the operation of transmitters operating on any frequency within the limits indicated without any tuning adjustments except for sensitivity. While the device requires a signal input of greater than 10 millivolts to produce an audible indication, a signal input of 2 millivolts can be detected visually in an Electron Ray Tube.

As in the case of ordinary radio receivers, the sensitivity of the Aperiodic Receiver is dependent upon the physical dimensions of the antenna used. For example, if the effective height of the antenna is 10 meters, audible indication will be obtained on signals having a field intensity of 1 millivolt per meter.

THEORY

The Aperiodic Receiver consists of a grid leak type untuned detector, directly coupled to an antenna and using a type 1G⁴ tube. The change in plate current caused in this tube by the application of a signal to its grid results in a voltage change across its plate load resistor R⁴ which, in turn, is applied to the grid of a DC amplifier, using the type 6F⁵ tube. Following the DC amplifier is a vacuum tube bridge consisting of two type 6G⁶ tubes. The amplified signal appearing across the plate load resistor R⁸ of the DC amplifier is applied to the grid of the Active tube in the V. T. Bridge. The plate of the Bridge Detector tube is connected to the Active Bridge tube plate while the cathode of the Bridge Detector tube is connected to the plate of the Inactive Bridge tube. At balance the plates of the V. T. Bridge tubes are at the same potential and hence there is no current flow between the plate and the cathode of the type 6C⁵ tube. The circuit is arranged so that when a signal is applied to the grid of the 1G⁴ tube, the plate of the Active Bridge tube becomes positive with respect to the plate of the Inactive Bridge tube and the type 6C⁵ tube functions as an amplifier. When this occurs, an audio frequency voltage that is applied to the grid circuit of the type 6C⁵ Detector tube from the audio oscillator (Type 6SC⁷ tube) through capacitor C⁷ is amplified and appears across the primary of the Bridge Detector tube output transformer T¹. This audio voltage appears across the secondary winding of the transformer and is applied through a volume control (R²⁵) to the grid of the output audio stage (type 6V⁶ tube) and can be heard in the loudspeaker coupled to the plate circuit.

In the absence of a signal, as for instance when S⁴ is closed, it is necessary that the V. T. Bridge be balanced, otherwise, voltage appears in the plate circuit of the type 6C⁵ tube and thus causing a continuous tone to be heard in the loudspeaker. Balance of the bridge is accomplished by adjustment of R⁵ (Course) and R⁶ (Vernier). Accomplishment of balance can be observed by noting that the shadow angle of the type 6U⁵ Electron Ray tube is almost closed. Manipulation of the balance controls beyond this point will cause type 6U⁵ tube to overlap and a continuous audio tone will be

heard in the speaker. On the other hand, if the balance control is turned in the opposite direction, type 6U5 tube will open to a 90° angle and cause the bridge to have lower sensitivity for all applied signal voltages. For maximum sensitivity the balance controls must be adjusted so that the Electron Ray tube indicates an angle between 0° and 10°.

The V. T. Bridge can be balanced so as to enable reception of type A1 or A2 emission signals operating in the presence of a modulated carrier signal such as those emitted by near-by broadcast stations. Under such operation, the audio modulation could be annoying but can be greatly attenuated by applying the audio component to both V. T. Bridge tube grids. This is accomplished by manipulation of the "Phase" control resistor R10. If reception of type A3 signals is desired, the Audio oscillator should be made inoperative and for maximum sensitivity, signal is applied only to the Active Bridge tube grid, by reducing "Phase" control.

The purpose of the type 6SL7 tube is to provide an electrical means for starting a signal recorder whenever a transmission occurs. Audio voltage is taken from across the primary of the output transformer T2 and through the "Relay Sensitivity" control R23 is applied to one grid and plate of the type 6SL7 tube, these elements serving to rectify the Audio signal. The rectified voltage is passed through the time constant circuit R29, C13 and then applied to the second grid of the type 6SL7 tube. The signal appearing in the plate circuit of this portion of the tube actuates a relay whose contacts may be made to start and stop a signal recorder inserted in receptical P1. The time constant circuit has been designed so that the relay closes instantly with the first element of the input signal and remains closed as long as the transmission of signal occurs. The time delay in the drop out of the relay is variable and is controlled by the adjustment of the Relay Sensitivity control R23.

The power supply of the Receiver consists of Power Transformer T3, rectifier tube type 5Z3. Filtering is obtained by suitable chokes and condensers. Regulation of important voltages is accomplished by Voltage Regulator tubes type VR105 and VR150 connected in series.

OPERATION

Assuming that the Aperiodic Receiver has been connected to a source of AC power with all controls in the "Off" position and that an antenna and ground has been connected to the posts appropriately marked, advance "Volume" control knob to midway position. This applies filament power to all tubes. After 15 seconds warm-up period, turn "Plate Volts" to "On" position. Turn "Oscillator Control" to "On" position and manipulate the Balance and Balance Vernier controls until the Electron Ray Tube indicates balance. The Aperiodic Receiver is now ready for operation if the "Ant. Sw." is turned to the "On" position. If this last operation causes the Electron Ray Tube to overlap and an audio tone is heard from the speaker, this is an indication that an R. F. carrier is being received. If this is not the signal desired, readjust "Balance" and "Balance Vernier" until balance is restored as indicated by the Electron Ray Tube. If the undesired R. F. carrier is modulated, manipulate the "Phase" control for maximum attenuation of modulation. Large changes in power line voltage will cause V. T. Bridge unbalance and will immediately be indicated by the Electron Ray Tube. Under this circumstance the bridge should be rebalanced in order to maintain maximum sensitivity. For headphone operation, insert the phone plug in jack marked "Phones". This jack may be used for feeding the output of the Aperiodic Receiver into the input terminals of a signal recorder such as a dictaphone.

If it is necessary to operate the Aperiodic Receiver near a strong interfering radio station, it is recommended that a Series Type Wave Trap be connected between the antenna and ground binding posts and tuned to the operating frequency of the interfering station. A Parallel Type Wave trap will not be effective because of the high input impedance of the Aperiodic Receiver.

The Aperiodic Receiver can be operated from a storage battery in a manner similar to that used in the Hallicrafter Type SX28 receiver. The octal plug on the rear of the chassis is wired in a fashion similar to the Hallicrafter plug. It is pertinent, however, to point out the Aperiodic Receiver will not operate satisfactorily with the type VP-2 vibrapack because the input high voltage supply required is 375 volts, whereas, the vibrapack is capable of furnishing approximately 300 volts. The type A. T. R. converter can be used successfully provided the filament voltage for the Aperiodic Receiver is obtained directly from the storage battery instead of the filament winding on the power transformer T3. This is necessary because the power required for the Aperiodic Receiver is approximately 80 watts and with this load the type A. T. R. converter is not capable of furnishing 110 volts.

MAINTENANCE

The voltages taken from the adjustable resistors R32 and R33 are critical as to adjustment and have been carefully set by the manufacturer. In the event V. T. Bridge cannot be balanced by manipulating the Balance Controls R5 and R6, it may be necessary to readjust the variable tap furnishing bias to the cathode of the type 6F5 DC amplifier. This adjustment is critical and should not be made without a complete understanding of the circuit functions. The tap on the resistor R32 furnishes fixed bias to the grid of the Inactive Bridge tube. This adjustment is not critical but should be made for 60 volts to 70 volts. The tap on the resistor which furnishes plate voltage to the type 1G4 tube is also not critical but should be roughly 30 volts to 40 volts. The position of the tap on R33 furnishing fixed bias to the 6F5 amplifier tube is critical in adjustment and depends upon the electrical characteristics of both the type 1G4 tube and the type 6F5 tube. If it is necessary to adjust the last mentioned tap, set the "Balance Control" resistors to mid position and adjust the tap until the Electron Ray tube just closes or until a weak audio signal is heard in the speaker. CAUTION--Care should be exercised in adjusting the resistor clamp. Rough treatment may damage the resistance wire.

- R1 5 Meg. $\frac{1}{2}$ watt
- R2 300 ohm $\frac{1}{2}$ watt
- R3 300 ohm $\frac{1}{2}$ watt
- R4 300M ohm $\frac{1}{2}$ Watt
- R5 2000 ohm pot. Balance Control
- R6 200 ohm pot. Balance Control
- R7 1250 ohm $\frac{1}{2}$ Watt
- R8 300M ohm $\frac{1}{2}$ Watt
- R9 20M ohm 10 Watt
- R10 500M ohm pot. Phase Control
- R11 10M ohm 10 Watt
- R12 2000 ohm 10 Watt
- R13 10M ohm 10 Watt
- R14 15M ohm 10 Watt
- R15 40M ohm $\frac{1}{2}$ Watt
- R16 1500 ohm $\frac{1}{2}$ Watt
- R17 100M ohm $\frac{1}{2}$ Watt
- R18 25M ohm $\frac{1}{2}$ Watt
- R19 25M ohm $\frac{1}{2}$ Watt
- R20 25M ohm $\frac{1}{2}$ Watt
- R21 25M ohm $\frac{1}{2}$ Watt
- R22 10M ohm $\frac{1}{2}$ Watt
- R23 25M ohm pot. Relay Sensitivity
- R24 750 ohm 10 Watt
- R25 100M ohm pot. Volume Control
- R26 1 Meg. $\frac{1}{2}$ Watt
- R27 750 ohm $\frac{1}{2}$ Watt
- R28 50M ohm $\frac{1}{2}$ Watt
- R29 20 Meg. $\frac{1}{2}$ Watt
- R30 3M ohm 10 Watt
- R31 10M ohm 10 Watt
- R32 5M ohm 10 Watt Adj.
- R33 10M ohm 10 Watt Adj.
- C1 100 mmf mica
- C2 100 mmf mica
- C3 100 mmf mica
- C4 .01 mf 600V. paper
- C5 .1 mf 600V. paper
- C6 .1 mf 600V. paper
- C7 .03 mf 600V. paper
- C8 .006 mf 600V. paper
- C9 .006 mf 600V. paper
- C10 .2 mf 400V. paper
- C11 50 mf 25V Electrolytic
- C12 .01 mf 600V. paper
- C13 .25 mf 600V. paper
- C14 8 mf 600V. Electrolytic
- C15 8 mf 450V. Electrolytic
- C16 8 mf 450V. Electrolytic
- C17 8 mf 450V. Electrolytic
- T1 3 to 1 interstage Transformer
- T2 Output Transformer
- T3 Power Transformer
- L1 .035 Hy.
- S1 S.P.S.T. Switch
- S2 S.P.S.T. Switch
- S3 S.P.S.T. Switch
- S4 S.P.S.T. Switch
- P1 A.C. Receptical
- P2 Octal Plug
- F1 2 Amp Fuse

Terminal Voltages

Potentials measured with 1000 ohm per volt voltmeter and with V. T. Bridge in balance.

Tube	Pin No	PLATE to GND.	Pin No	SCREEN to GND.	Pin No	CATH. to GND.	Pin No	GRID to GND.	Pin No	FIL. to GND.
1G4	3	.7					5	0	2	1.4 DC.
6F5	4	4.3			8	8.5	GRP	.7	2	6.3 AC
6G6 <small>ACTIVE</small>	3	250	4	180	8	65	5	50-60	7	6.3 AC
6G6 <small>INACTIVE</small>	3	250	4	180	8	65	5	58	7	6.3 AC
6C5	3	245			8	245	5	200	7	6.3 AC
6SC7	5 2	210 240			6 6	0 0	4 3	0 -.5	8	6.3 AC
6SL7	5 2	0 400			6 3	0 2	4 1	0 0	8	6.3 AC
6V6	3	400	4	250	8	17	5	0	7	6.3 AC
5Z3	3	420							4	5 AC

UNITED STATES PATENT OFFICE

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APERIODIC RADIO RECEIVER

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The invention described herein may be manufactured and used by or for the Government of the United States for governmental purposes without the payment to us of any royalty thereon in accordance with the provisions of the act of April 30, 1928 (Ch. 460, 45 Stat. L. 467).

This invention relates to an aperiodic radio receiver and more particularly to a radio receiver capable of responding to transmitted signals through a large frequency range.

It is desirable, in monitoring all radio transmission in a locality, to use a receiver capable of indicating transmission by any of a large number of methods. Law enforcement agencies, in particular, have need of a radio receiver which will detect radio transmission when the time, frequency and type of transmission are unknown. The required receiver must, when placed in a suspected area, give an indication when a relatively strong radio-frequency field is created.

Previous attempts to produce such an aperiodic receiver, in which sensitivity was sought by use of radio-frequency amplifiers, have not been satisfactory because no method has been found which will accomplish the required amplification over a wide range of frequencies.

One object of this invention is to provide a radio receiver capable of responding simultaneously to radio signals transmitted on any of a large range of frequencies.

Another object of this invention is to provide a radio capable of responding to radio communication through a large range of frequencies without the necessity of tuning to a particular frequency or group of frequencies.

Another object of this invention is to provide a radio capable of responding to a wide variety of types of radio transmission.

A further object of this invention is to provide an aperiodic radio receiver capable of responding to keyed continuous wave radio signals.

Other objects will become apparent from the following specification taken in connection with the accompanying drawing which shows a schematic diagram embodying the principles of this invention.

Referring now to the drawing for a general description of the invention, section 1 includes the antenna, input circuit and detector. Section 2 comprises a "push-pull" balanced amplifier. Section 3 is an oscillator capable of producing an audible local frequency. Section 4 includes a "push-pull" balanced amplifier and an output indicator.

In operation, a signal is received and detected in section 1 and supplied to section 2 which is unbalanced thereby. The local frequency produced by section 3 is also applied to section 2 which when unbalanced passes on the local fre-

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quency to section 4 where it is further amplified and indicated.

To explain the invention in further detail, section 1 includes antenna A connected in series with condenser C₁, inductance coils RFC₁ and RFC₂ and thence to filament F₁ of tube V₁. Batteries B₁, B₂, B₃, and B₄ are connected in series, the filament F₁ being connected to leads #1 from battery B₁. Batteries B₁ and B₃ supply 1.5 volts, while batteries B₂ and B₄ supply 45 volts. Ground is effectively placed between batteries B₃ and B₄ by connections through leads #2 from battery B₃ to filament F₂ of tube V₂.

The conductor between condenser C₁ and choke RFC₁ is connected through condenser C₂, connected in parallel with resistor R₁, to control grid G₁ of tube V₁. Screen grid S₁ of tube V₁ is connected through resistor R₂ to a central tap on battery B₂. Plate P₁ of tube V₁ is connected through resistor R₃, rheostats R₄ and R₅, and potentiometer R₇ to the negative side of battery B₁. The junction of rheostats R₄ and R₅ is connected to ground through condenser C₅. Plate P₁ is also connected through condensers C₃ and C₄ to ground. The junction of condensers C₃ and C₄ is connected to screen grid S₁ of tube V₁.

The plate P₁ of tube V₁ is also connected in direct current connection to the first control grid G₂ of tube V₂ of section 2. Tube V₂ is connected in balanced push-pull relation with tube V₃, the filaments F₂ and F₃ being connected in parallel and supplied with current through leads #2 of battery B₃. One side of filaments F₂—F₃ is grounded. Screen grids S₂ and S₃ of tubes V₂ and V₃, respectively, are connected together and through resistor R₁₀ to the junction of equal resistors R₈—R₉ which are connected in series between the plates P₂ and P₃ of tubes V₂ and V₃, respectively. The junction of resistors R₈—R₉ is also connected to the positive side of battery B₄. First control grid G₃ of tube V₃ is connected through resistor R₆ and potentiometer R₇ to the negative side of battery B₁. The junction of resistor R₆ and potentiometer R₇ is connected to ground through condenser C₆.

Section 3, the local oscillator, includes tube V₆ the filament F₆ of which is connected through leads #2 to battery B₃. The grid G₆ of tube V₆ is connected through condenser C₁₂ to one end of the center-tapped primary of transformer T₁. The other end of said primary is connected to the plate P₆ of tube V₆. Condenser C₁₁ is connected across the primary of transformer T₁, the center tap of which is connected through resistor R₁₂, and switch SW₁ to the positive side of battery B₄. Said center tap is also connected to ground through condenser C₁₀. The filament F₅ is connected through resistor R₁₃ to grid G₆.

The secondary of transformer T_1 is connected through condenser C_{13} to the second control grids M_2 and M_3 of tubes V_2 and V_3 , respectively. Control grids M_2 and M_3 are connected to ground through resistor R_8 .

Plate P_2 of tube V_2 is connected through one of the two equal condensers C_9 — C_9 to grid G_4 of tube V_4 of section 4. Plate P_3 of tube V_3 is connected through the other of condensers C_9 — C_9 to grid G_5 of tube V_5 , also of section 4. Grids G_4 and G_5 and connected together through condensers C_8 — C_8 connected in series and also through resistors R_{11} — R_{11} connected in series. The junction of the two equal condensers C_8 — C_8 is connected to ground. Filaments F_4 and F_5 of tubes V_4 and V_5 are connected through leads #1 to battery B_1 . The junction of resistors R_{11} — R_{11} is connected through battery B_5 to filament F_4 — F_5 . Balancing condensers C_8 — C_8 are of equal capacitance and have a reactance approximately at the third harmonic of the audio-frequency supplied by section 3. The reactance of the condensers C_8 — C_8 is somewhat less than the resistance of resistor R_9 in order to maintain good balance.

The plates P_4 and P_5 of tubes V_4 and V_5 , respectively, are connected to either end of the center-tapped primary of transformer T_2 . Plates V_4 and V_5 are connected through the center tap of said primary of transformer T_2 to the positive side of battery B_4 . Screen grids S_4 and S_5 of tubes V_4 and V_5 , respectively, are connected to the center tap of the primary of transformer T_2 . The secondary of transformer T_2 is connected to a speaker.

In operation radio-frequency energy is collected by antenna A causing a voltage to appear across inductances RFC_1 and RFC_2 . C_2 is an isolating condenser to prevent any direct potential from entering the receiver. C_2 , however, provides a path for the radio-frequency energy. RFC_1 and RFC_2 have a combined series impedance which is high compared to the antenna impedance for all frequencies in the required range.

A wire of infinite length would make the best antenna for the receiver described herein. However, for practical purposes the size of antenna A must be governed by the expected field strength and the space available. Marked variations in response versus frequency will be experienced with short antennas. Relatively large inductance RFC_2 is used to allow low frequencies to be impressed across the grid G_1 and filament F_1 of detector tube V_1 . Due to high distributed capacity, high inductance RFC_2 offers a low impedance path to high frequency energy. A separate small inductance RFC_1 is provided to impress high frequencies on the detector.

Tube V_1 , a pentode type vacuum tube with low input capacity, acts as a "grid leak detector" performing the dual function of rectification, by diode action of the grid G_1 and filament F_1 , and amplification of the direct current voltage produced in case of a continuous unmodulated radio-frequency and the low frequencies of a modulated carrier. Resistor R_1 and condenser C_2 provide a "grid leak and condenser." A voltage appearing across impedances RFC_1 and RFC_2 will cause rectification between grid G_1 and filament F_1 of tube V_1 . The resultant current flow will cause a negative voltage to build up on grid G_2 and store in condenser C_2 . This negative grid voltage causes a reduction in the plate current of tube V_1 and therefore a reduction in the voltage drop across resistors R_3 , R_4 and R_5 . If the voltage across impedance RFC_1 and RFC_2 is reduced, the

negative voltage on grid G_1 will tend to leak away over resistor R_1 .

Resistor R_2 provides the correct voltage for proper operation of screen grid S_1 or tube V_1 . C_3 is a by-pass condenser of sufficient size to reduce the amplitude of high frequency voltage appearing on the plate of tube V_1 but not so large that an appreciable attenuation of modulation frequencies will result. Resistors R_3 , R_4 and R_5 are a combined series of plate resistors such that the resultant plate potential of tube V_1 will be slightly negative in relation to the negative filament point of V_2 and of equal potential to the equivalent grid G_3 of tube V_3 with no signal, or a selected input signal, impressed upon the receiver. Resistors R_4 and R_5 are variable to allow adjustment of this potential and therefore balance the system. Resistor R_4 is made large with respect to R_5 so that rough and fine adjustment of balance may be made. Condenser C_5 is an audio by-pass for the plate return circuit of tube V_1 .

Resistor R_7 is a variable resistor to permit initial adjustment of the bias on tube V_3 . The sensitivity may be controlled to some extent by this adjustment. Condenser C_6 is the by-pass for this control. Resistor R_6 simulates the resistance in the circuit of grid G_2 of tube V_2 and allows grid G_3 to operate under the same conditions as grid G_2 . Resistor R_{10} provides proper screen voltage for screen grids S_2 and S_3 of tubes V_2 and V_3 . Resistor R_{10} is by-passed for audio-frequency by condenser C_7 .

In section 3, the primary of transformer T_1 and condenser C_{11} act as a tank circuit and receive power from the filament-plate circuit of triode T_6 to produce an audible tone. The grid G_6 of triode V_6 is coupled to the tank circuit through condenser C_{12} to give the necessary feedback to produce oscillation in the tank circuit. Resistor R_{13} prevents the voltage of grid G_6 from floating. Resistor R_{12} and condenser C_{10} are used as a filter to prevent the tone produced by section 3 from spreading through the battery to other circuits. Condenser C_{13} is used to couple the audio-tone produced by section 3 to the control grids M_2 and M_3 of tubes V_2 and V_3 . Resistor R_8 provides a path for rectified audio-current resulting from the application of a strong audio source to grids M_2 and M_3 which are only slightly biased.

With equal voltages applied to grids M_2 and M_3 of tubes V_2 and V_3 , as long as equal voltages are applied to grids G_2 and G_3 , equal voltages will appear across resistors R_3 — R_5 and be applied through coupling condensers C_9 — C_9 to grids G_4 and G_5 of tubes V_4 and V_5 . With equal voltages applied to grids G_4 and G_5 equal and opposite currents will flow through the primary of transformer T_2 and no current will be induced in the secondary of transformer T_2 and impressed on the speaker. However, if the voltage on grid G_2 is varied with respect to the voltage on grid G_3 , the balance of the system is impaired and an indication will be given at the speaker.

For reception of keyed unmodulated radio-frequency energy, the apparatus is balanced by removing the antenna A , turning the audio-oscillator on by closing switch SW_1 and adjusting resistors R_4 and R_5 until no signal, or until a selected minimum signal, is heard at the speaker. The antenna is then connected. If a radio telegraph station of sufficient intensity is then operated, a signal will be collected by antenna A detected by tube V_1 and impressed on grid G_3 of

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tube V_2 as explained above. As the original adjustment for balance resulted in equalizing the voltages on grids G_2 and G_3 , the change caused by the received signal will unbalance the circuit and cause the audible tone from section 3 to be amplified in section 4 and reproduced by the speaker. If the transmitter is keyed, obviously the tone will appear and disappear in accordance with the keying. For reception of modulated radio signals, it is only necessary to turn off the local oscillator in section 3 by opening switch SW_1 and adjust resistors R_4 and R_5 for the most sensitive position. In this case sections 2 and 4 act simply as audio-amplifiers.

An increase in sensitivity may be obtained by using a separate diode rectifier replacing the grid rectifier and allowing tube V_1 to act purely as a direct current amplifier. Additional direct current amplifiers may be added increasing the sensitivity to the limit set by the noise generated in the input circuit. It will be understood that when keyed, unmodulated radio-frequency energy is being received, a long pulse of continuous wave will result in only direct current flowing through the circuit after detection and before the local oscillation is applied in section 2. An aperiodic input to the receiver is most readily obtained by using a rectifying element with extremely low input capacity and by using sectionalized inductances to reduce the input capacity. If this input capacity can be kept low in relation to the antenna capacity the response will remain relatively constant through a large range of frequencies. As stated previously, the length of the collector wire will generally be the determining factor.

If the sensitivity of an efficient aperiodic receiver is increased sufficiently many signals will be heard simultaneously. Under such conditions it is possible to reduce the receiver band width, and therefore, the number of stations received, by the use of suitable filters. Such filters may be inserted ahead of the input circuit and may be any of the usual forms, such as band pass, band elimination, or simple resonant circuit. The addition of a simple tuned circuit will increase the sensitivity materially by reducing the detrimental effects of a collector of finite length. A calibrated tuned circuit can be used to determine the approximate frequency of the received signal and aid in locating the exact frequency when using other receiving systems.

In place of the audio reproducer shown in the drawing a visual indicator such as a meter or cathode ray tube may be used to indicate reception of a signal. In this case an indication of the signal intensity may be obtained. Various types of recording systems may be used with the receiver to permit automatic monitoring with the receiving equipment unattended. The indicator could be arranged to show intensity against frequency.

The above specification and drawing describe a preferred embodiment, but many modifications within the scope of the appended claims will occur to those skilled in the art.

What is claimed is:

1. In combination an antenna connected to at least one inductance coil, a first electronic discharge device having at least a plate, control grid, and cathode electrodes, said control grid being connected to one side of said inductance coil through a capacitor shunted by a resistor, said cathode being connected to the other side of said

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inductance coil, whereby said first electric discharge tube functions as a grid leak detector, a second and third electric discharge device each having at least a plate, cathode, and first and second control grid, the cathode of said first and second electric discharge device being connected together, the first grid of said second electric discharge device being connected directly to the plate of said first electric discharge device, the first grid of said third electric discharge device being connected to an adjustable source of potential whereby the first grid of the third electric discharge device may be adjusted to the normal potential of the first grid of the second electric discharge device, means for producing a local frequency, means for supplying said frequency to the second grids of said second and third electric discharge device, the plates of said second and third electric discharge device being connected in opposition in an output circuit whereby the local frequency does not appear in said output circuit unless radio energy is received by said antenna.

2. An antenna connected to an impedance, a detector connected across said impedance, said detector having an output, first and second vacuum tubes each having first and second control electrodes and an output electrode, said output electrodes being connected in opposition, an oscillator for producing a local frequency, means for applying said local frequency to the second control electrodes of each of said first and second vacuum tubes, a direct connection between the output of said detector and the first control electrode of one of said vacuum tubes, means for applying an adjustable steady potential to the first control electrode of said second vacuum tube equal to that existing on the first control electrode of said first vacuum tube when no radio signal is received by said antenna whereby when a radio signal is received by said antenna the first and second vacuum tubes become unbalanced and produce an output.

3. An antenna connected to an impedance, a grid-leak detector having an input and an output, said input being connected across said impedance, an amplifier stage comprising a first and second vacuum tube each having a first and second input and an output, the output of said detector being directly connected to the first input of said first vacuum tube, the first input of said second vacuum tube being connected to an adjustable source of potential, a device for generating a local frequency, means for supplying said local frequency to the second input of said first and second vacuum tubes, said outputs of said first and second vacuum tubes being connected in opposition, and switching means operable to prevent application of said local frequency to said second inputs.

JAMES P. VEATCH.
WILLIAM J. HOFFERT.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,464,322	Kolster	Aug. 7, 1923
1,593,837	Mathieu	July 27, 1926
1,615,636	Langmuir	Jan. 25, 1927
2,127,525	Marshall	Mar. 19, 1940
2,383,126	Hollingsworth	Aug. 21, 1945
2,400,133	Pray	May 14, 1946