

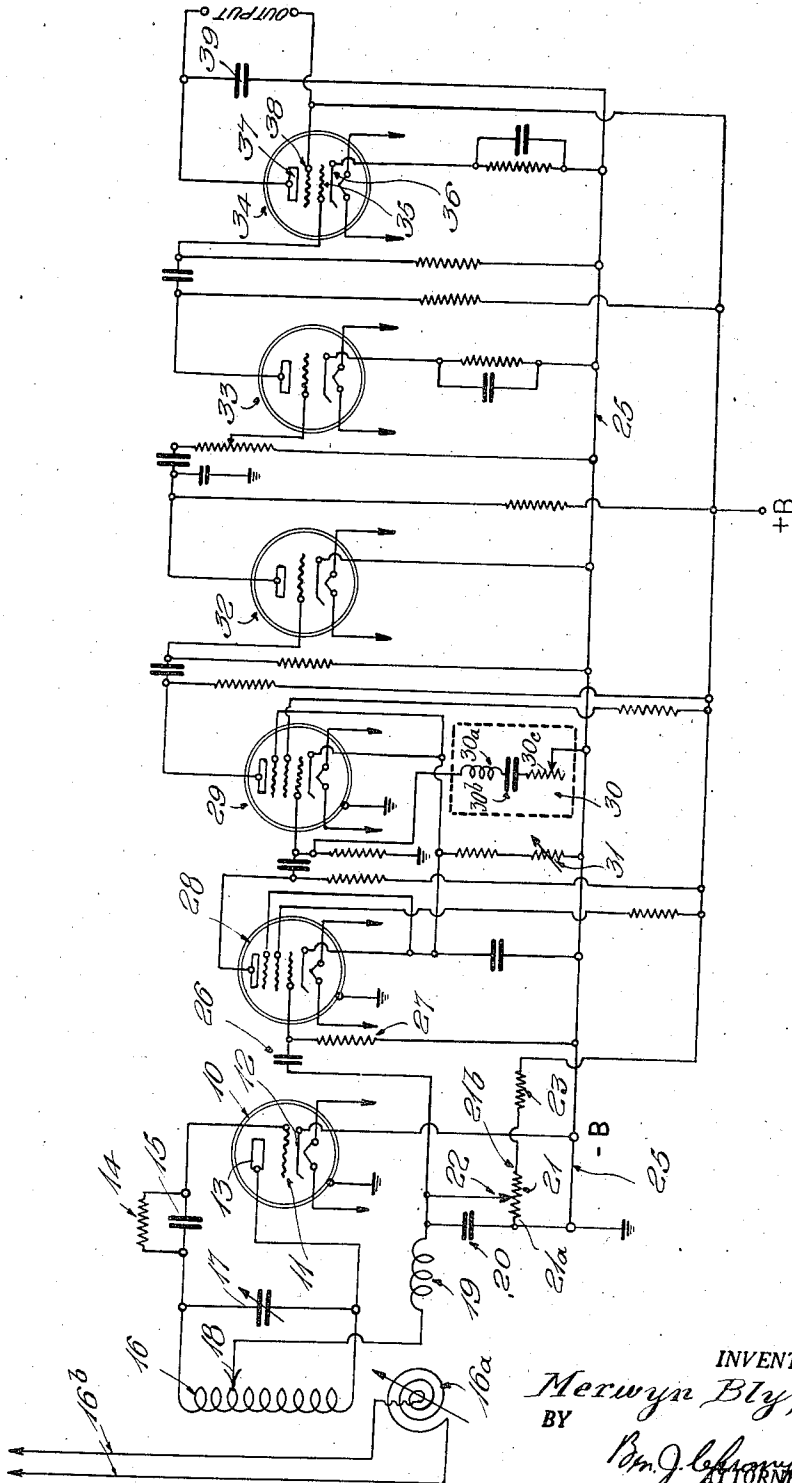
Dec. 31, 1940.

M. BLY

2,226,657

ULTRA SHORT WAVE RADIO RECEIVER

Original Filed June 6, 1938



INVENTOR.
Merwyn Bly,
BY
Ben J. Leary
ATTORNEY.

UNITED STATES PATENT OFFICE

2,226,657

ULTRA SHORT WAVE RADIO RECEIVER

Merwyn Bly, Leesburg, Va.

Application June 6, 1938, Serial No. 212,154

Renewed May 13, 1940

11 Claims. (Cl. 250—20)

This invention relates to radio signal receivers in general. More particularly this invention relates to radio signal receivers adapted for use with radio frequencies known as ultra high frequencies.

5 An object of this invention is to produce an ultra high frequency radio receiver of very high sensitivity and with a minimum of so called background noise.

10 Another object of this invention is to provide an ultra high frequency radio receiver employing the super-regeneration principle and a novel circuit arrangement for adjusting the circuit.

15 Still another object of this invention is to provide an ultra high frequency radio receiver employing a circuit arrangement which may be made to function simply as a regenerative or as a super-regenerative receiver at will.

20 A further object of this invention is to provide a radio receiver adapted for use with ultra high radio frequencies, employing a novel coupling circuit arrangement between the ultra high frequency detector and an amplifier whereby said detector may be operated as a super-regenerative tube for receiving ultra high frequency signals.

25 Another object of this invention is to provide a radio receiver adapted for the efficient reception of ultra high frequency radio signals and employing a variable resistance control for varying the effect of the super-regenerative action in the circuit.

30 Still another object of this invention is to provide a variable resistance super-regeneration control in a radio receiver, said variable resistance being also adapted to function as a part of an inter-tube coupling circuit.

35 Other and further objects of this invention will be apparent from the following specification and claims.

40 In accordance with this invention I provide a radio receiver circuit arrangement that is extremely sensitive and efficient in the reception of ultra high radio frequency signals.

45 The receiving system of my invention is especially useful for receiving ultra high frequency signals although the same system may be adapted to other frequencies if desired.

50 Among the main features of my invention are the ease with which the receiver is adjusted and used and the sensitivity that it possesses whereby signals not heard on conventional receivers may be received on it with good signal strength.

55 The first detector tube of my radio receiver, in cases where my invention is incorporated into a superheterodyne, is arranged to produce the quenching oscillations enabling this tube to op-

erate as a super-regenerative detector tube. The current to the plate of this detector tube is fed thereto through a novel circuit arrangement which permits the super-regenerative action of this tube to be controlled and/or stopped and furthermore enables the operator to control the quenching frequency of this tube so that an optimum frequency may be selected for different frequency signals to be received. Enormous amplification is produced by this tube enabling the reception of very weak signals. However should it be desired to receive signals of substantial intensity for which this amplification was not necessary, the super-regenerative action of the detector may be stopped by this plate current control as will be explained in detail hereinafter and the detector operated simply as a regenerative detector.

Further details of this invention will be apparent from the following specification and the drawing in which the sole figure illustrates schematically a circuit arrangement incorporating my invention.

Referring to the drawing in detail reference numeral 10 designates a triode vacuum tube which may be of the type commercially designated as 6C5. This type of tube is normally provided with a metal shield that should be connected to the metal chassis or frame of the radio receiving set. The tube 10 is provided with a grid 11, an indirectly heated cathode 12 and a plate or anode 13. The grid 11 is connected to the grid leak and grid condenser 14, 15 and through these to the tuned circuit including the inductance 16 connected in parallel with the variable condenser 17. The anode 13 is connected to the aforesaid tuned circuit at the end opposite to that to which the grid 11 is connected.

A small antenna coupling coil 16a is coupled to the anode end of the inductance 16 for inductively or otherwise impressing radio signal energy upon the circuits of the tube 10. The coupling coil 16a is connected to any suitable type of antenna, adapted for receiving ultra high frequency signals, by means of the wires 16b. These wires 16b are covered by insulation and twisted in order to minimize their adaptability for picking up interference and transmitting such interference to the coupling coil. It is of course obvious that the wires 16b may be made up in the nature of a concentric cable in which case the outer member of the concentric cable functioning as one of these wires is preferably grounded. Furthermore both of the wires 16b may be positioned inside of a grounded metal

conduit and in that case of course both of these wires would be insulated from the metal conduit although they may be connected by suitable devices, such as, one or more inductances or capacities to the metal conduit.

It is, of course, obvious that one or more stages of radio frequency amplification using the screen grid acorn type tube may be used between the antenna circuit and the circuit of the detector 10 so as to isolate the antenna from the detector to prevent radiation of frequencies developed in the detector circuits and to facilitate and stabilize the control of the regenerative or super-regenerative action of the detector.

A tap 18 is provided to the inductance 16 and the inductance coil 19 is connected to this tap. The condenser 20 is connected to the inductance 19 and to the cathode 12 of the tube 10. This condenser 20 and inductance 19 are arranged to cooperate together and with the other elements associated with the tube for producing super-regenerative action in the vacuum tube circuit.

This super-regenerative action may be controlled by the variable resistor or potentiometer 21 provided with a variable contact 22 which is connected to the inductance 19 and condenser 20 in such a way that it may be used to control the amount of the potentiometer resistance connected across the condenser 20. For example, when the contact 22 is moved toward the end 21a of the potentiometer the condenser 20 is virtually short-circuited through a low resistance connection. However, when the contact 22 is moved toward the end 21b of the potentiometer considerable resistance is shunted or connected across this condenser 20.

I have found that this arrangement of varying the resistance shunted across the condenser 20 possesses very desirable characteristics and is extremely useful for controlling the super-regenerative action of the tube 10 and in controlling the frequency of the quenching oscillations.

Another resistance 23 is connected in series with the potentiometer 21 in such a way that the anode current for the tube 10 passes through this resistance 23. The signal output from the tube 10 is impressed upon a control grid of the multi-grid tube 28 through the coupling condenser 26 and across the grid resistor 27 connected to this control grid. The tubes 28 and 29 are both of the 6K7 type connected in cascade to function as intermediate frequency amplifiers and produce an enormous amplification of the signal modulated voltage. The output circuit of the tube 28 includes a plate resistor, which is connected to the positive terminal of the anode current supply, and a suitable coupling condenser for impressing energy from the output of tube 28 on a control grid of the tube 29 whereby the signal fed to tube 29 is impressed across the grid resistor of this tube and across a filter circuit 30. This filter circuit includes a choke coil 30a, a condenser 30b and a variable resistor 30c and has a definite "peak" at the high frequency end of the audio frequency spectrum for the purpose of absorbing interference noises occurring in the form of hissing which appears to have a definite relationship to the quenching frequency or frequencies. I have also found that the operation of this filter is most efficient and beneficial for this purpose when the filter is connected across the grid resistor of the tube 29.

A variable resistor 31 is also connected in the circuit of the cathode of the tubes 28 and 29 for the purpose of varying the biasing potential of

these cathodes with respect to the control or other grids of the tubes 28 and 29 or vice versa. If desired a separate control such as the resistor 31 may be provided to each of the tubes 28 and 29 whereby this control may be adjusted for these tubes individually.

Signal modulated energy obtained from the output of the amplifier tube 29 is impressed upon the input of the detector tube 32 which is of the triode type and is coupled to the input circuit of the audio frequency amplifier consisting of the tubes 33 and 34. The tube 33 is also of the triode type, however, the tube 34 is of a multi-grid type commercially designated 6V6G. The signal modulated energy is impressed upon the control grid 35 and the cathode 36. The output circuit which may consist of the primary of a transformer or of a suitable winding or windings of a reproducing device or of any other signal energy utilizing circuit, is connected to the anode 37 and grille electrode 38. The grille electrode 38 is connected to the positive terminal of the anode current supply and a small condenser 39 is connected between the anode and the conductor 25 which is connected to the metal chassis, to the negative terminal of the anode current supply and to the cathode circuits of the various tubes comprising the receiving circuit. Any conventional type of anode current supply may be employed on this radio receiving circuit. The cathode heaters of the various tubes also may be energized from any type of electric current supply although the use of a small alternating current transformer is perhaps the most economical for this purpose.

While I do not desire to be limited to any particular values or sizes of parts or circuit components employed in the radio receiving circuit set forth in this specification except insofar as such sizes or values may be set forth in the claims, I have found that the following elements when made of the following sizes or values, respectively, produce exceptionally good results in the reception of radio signals of approximately 5 meters wave length. The inductance 16 should consist of approximately 6 turns of $\frac{3}{4}$ inch diameter well spaced and the tap 18 should be positioned approximately 2 turns away from the grid end of the coil. The condenser 17 should of course be of such a size as to tune the inductance to the 5 meter or other high frequency signals to be received. A relatively high resistance grid leak 14 in the neighborhood of 10 megohms should be employed with the tube designated. The inductance 19 should consist preferably of about 40 turns wound in a single layer on a $\frac{3}{4}$ inch diameter form using wire of approximately No. 28 A. W. G. and the condenser 20 should be approximately 0.005 micro-farad capacity. The potentiometer 21 may have a total resistance of 30,000 to 50,000 ohms and for the values given the resistance between the end 21a and the tap 22 should be around 15,000 ohms. At this approximate value the super-regenerative action obtained produces the most satisfactory signal reception. The resistance 23 in series with the potentiometer 21 is approximately 50,000 ohms. The inductance 30a and capacity 30b of the filter 30 are of a size necessary to produce resonance in this circuit at the upper end of the audio frequency spectrum. Of course if this circuit is to be used to filter other frequencies the values of these units will necessarily have to be adjusted accordingly. The variable resistance 30c which is used to control the effect of the filter is of 75,000 ohms maximum resistance. The maxi-

imum resistance of the variable resistor 31 is 10,000 ohms. The size of the condenser 39 is approximately 0.01 micro-farad.

The operation of this radio receiving circuit is as follows: The variable contact 22 of the potentiometer 21 is adjusted so that super-regenerative action is obtained in the circuit of the tube 10, and the variable condenser 17 is varied in order to tune the circuit consisting of the inductance 16 and this condenser 17 to the frequency which it is desired to receive. At the same time the coupling between the antenna coil 16c and the inductance 16 is varied to obtain maximum sensitivity and efficiency. Should the super-regenerative action stop or become weak during the tuning operation then the position of the tap 22 is adjusted to produce or increase this action. When the received signal is accompanied by a relatively loud hissing noise then the action of the filter 30 is increased by decreasing the size of the resistance 30c so that the absorption circuit is given an opportunity to absorb the interfering noise or noises. Where desired either one or both the inductance 30a and the condenser 30b may be made variable to enable the operator to adjust this absorption circuit to other interference frequencies that may be present. More than one of these absorption circuits may be used, each having different frequency characteristics, if desired.

While I have described a certain embodiment of this invention in detail it is of course understood that modifications of the invention may be made without departing from the spirit and scope of the invention and therefore I do not desire to limit this invention to those exact details except insofar as they may be defined by the claims.

What I claim is:

1. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube adapted to function as a super-regenerative detector, a source of anode current supply for said detector, means for producing quenching oscillations for said detector tube, said means including an oscillatory circuit and a variable resistance device connected to shunt one of the elements of said oscillatory circuit for controlling the production of the quenching oscillations, at least a portion of said variable resistance device being connected in series with said anode current supply, means for impressing signal modulated energy on said detector and amplifying and signal reproducing means connected to said detector.

2. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube adapted to function as a super-regenerative detector, a source of anode current supply for said detector, means for producing quenching oscillations for said detector tube, said means including an oscillatory circuit and variable impedance means connected to shunt one of the elements of said oscillatory circuit for controlling the production of the quenching oscillations, at least a portion of said variable impedance means being connected in series with said anode current supply, means for impressing signal modulated energy on said detector and amplifying and signal reproducing means connected to said detector.

3. Radio receiving apparatus adapted for reception of ultra high frequency signals of the

order of five meters wavelength, comprising: a vacuum tube adapted to function as a super-regenerative detector, a source of anode current supply for said detector, means for producing quenching oscillations for said detector tube, said means comprising an oscillatory circuit including inductance and capacity elements and variable impedance means connected to shunt one of the elements of said oscillatory circuit for controlling the production of the quenching oscillations, at least a portion of said variable impedance means being connected in series with said anode current supply, means for impressing signal modulated energy on said detector and amplifying and signal reproducing means connected to said detector.

4. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube adapted to function as a super-regenerative detector, a source of anode current supply for said detector, means for producing quenching oscillations for said detector tube, said means comprising an oscillatory circuit including inductance and capacity elements and a variable resistance device connected to shunt said capacity element of said oscillatory circuit for controlling the production of the quenching oscillations, at least a portion of said variable resistance device being connected in series with said anode current supply, means for impressing signal modulated energy on said detector and amplifying and signal reproducing means connected to said detector.

5. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube having a cathode, grid electrode and an anode and adapted to function as a super-regenerative detector; a source of anode current supply for said detector, an antenna circuit; a tuned circuit connected between the grid and anode of said vacuum tube; means for impressing signal modulated energy from said antenna circuit upon said tuned circuit; an oscillatory circuit including an inductance and a capacity; means for connecting said oscillatory circuit to said tuned circuit for producing quenching oscillations for said vacuum tube; a variable resistance device having a variable portion adapted to be connected across one of the elements of said oscillatory circuit for controlling the production of said quenching oscillations; connections for connecting the resistance element of said variable resistance device across said source of anode current supply; signal reproducing means and means for impressing signal modulated energy from said vacuum tube on said signal reproducing means.

6. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube having a cathode, grid electrode and an anode and adapted to function as a super-regenerative detector; an antenna circuit; a tuned circuit connected to the electrodes of said vacuum tube; means for impressing signal modulated energy from said antenna circuit upon said tuned circuit; an oscillatory circuit including an inductance and a capacity; means for connecting said oscillatory circuit to said vacuum tube through said tuned circuit for producing quenching oscillations for said vacuum tube; a variable resistance device connected across said capacity of said oscillatory circuit;

means for varying the magnitude of said variable resistance device connected across said capacity for controlling the production of said quenching oscillations; a source of anode current supply for said detector connected to said variable resistance device, a portion of said variable resistance device other than the portion connected across said capacity being connected in series with said source of anode current, a signal reproducing means and means for impressing signal modulated energy from said vacuum tube on said signal reproducing means.

7. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube having a cathode, grid electrode and an anode and adapted to function as a super-regenerative detector, an antenna circuit, a tuned circuit connected to the electrodes of said vacuum tube, means for impressing signal modulated energy from said antenna circuit upon said tuned circuit, an oscillatory circuit including an inductance and a capacity, means for connecting said oscillatory circuit to said vacuum tube for producing quenching oscillations for said vacuum tube, a variable resistance device connected across said capacity of said oscillatory circuit; means for varying the magnitude of said variable resistance device connected across said capacity for controlling the production of said quenching oscillations; an intermediate frequency amplifier; a coupling circuit including said variable resistance device for connecting said intermediate frequency amplifier to said vacuum tube detector; an absorption circuit tuned to absorb hissing interference frequencies produced by said super-regenerative detector connected to said intermediate frequency amplifier; signal reproducing means and means for impressing signal modulated energy from said amplifier on said reproducing means.

8. Radio receiving apparatus adapted for reception of ultra high frequency signals of the order of five meters wavelength, comprising: a vacuum tube having a cathode, grid electrode and an anode and adapted to function as a super-

regenerative detector, an antenna circuit, a tuned circuit connected to the electrodes of said vacuum tube, means for impressing signal modulated energy from said antenna circuit upon said tuned circuit, an oscillatory circuit including an inductance and a capacity, means for connecting said oscillatory circuit to said vacuum tube for producing quenching oscillations for said vacuum tube, a variable resistance device adapted to have varying portions thereof connected across said capacity of said oscillatory circuit for controlling the production of said quenching oscillations; an intermediate frequency amplifier; a coupling circuit including at least a portion of said variable resistance device for connecting the output of said detector tube to the input of said amplifier; signal reproducing means and means for impressing signal modulated energy from said vacuum tube on said signal reproducing means.

9. Radio receiving apparatus as set forth in claim 2 further characterised in that said amplifying means comprises a pair of amplifier tubes and substantially aperiodic coupling means between said tubes and means for reducing interference frequencies resulting from the operation of said detector as a super-regenerative detector.

10. Radio receiving apparatus as set forth in claim 2 further characterised in that said amplifying means comprises a pair of multiple grid amplifying tubes and substantially aperiodic coupling means between said tubes and means for reducing interference frequencies resulting from the operation of said detector as a super-regenerative detector.

11. Radio receiving apparatus as set forth in claim 2 further characterised in that said amplifying means comprises a pair of multiple grid amplifying tubes and substantially aperiodic coupling means for connecting said tubes in cascade and a series resonant absorption circuit connected to the input circuit of the second of said amplifying tubes for reducing the noise level of the quench frequency of said detector.

MERWYN BLY.