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SHORT WAVE RECEIVER

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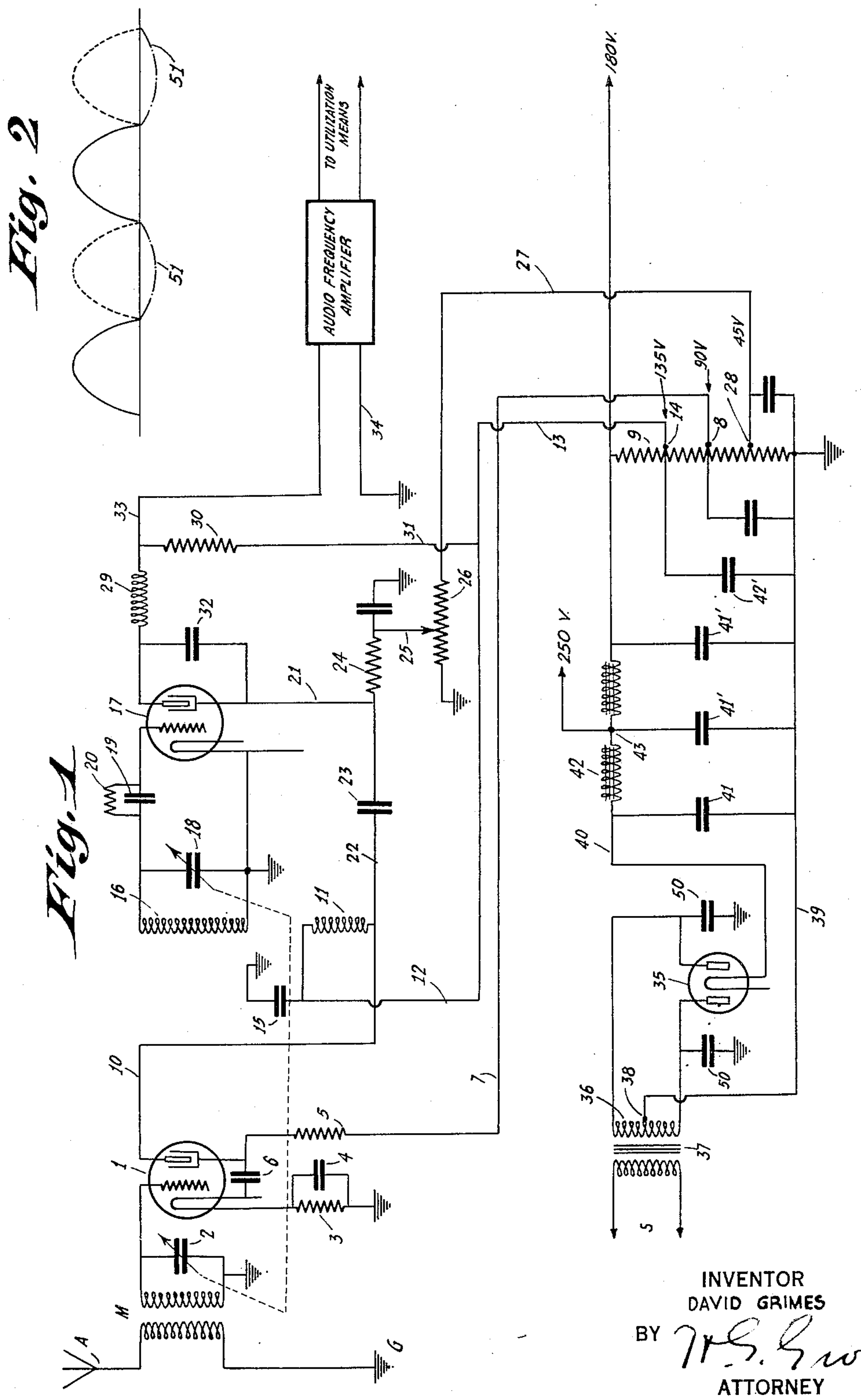

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SHORT WAVE RECEIVER

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3 Claims. (Cl. 250—27)

My present invention relates to radio receivers, and more particularly to short wave radio receivers adapted to be powered from alternating current sources.

It is one of the main objects of my present invention to provide in a short wave radio receiver, a novel and highly improved method of securing regeneration in the detector stage comprising an electron discharge tube of the screen grid type.

Another important object of the present invention is to provide in a short wave radio receiver employing a screen grid detector a novel and highly efficient arrangement for controlling regeneration, the arrangement comprising a variable impedance for regulating the potential applied to the screen of the detector tube.

Another object of the present invention is to provide in a short wave radio receiver a stage of tuned radio frequency amplification employing a screen grid tube, and a succeeding detector stage having a tunable input circuit, a common means for transferring energy from the output circuit of the amplifier tube to the said tunable input circuit of the detector stage and simultaneously transferring energy from the output circuit of the detector stage to its tunable input circuit.

Still another object of the present invention is to provide a short wave receiver adapted for use in connection with signals having wave lengths below one hundred meters, said receiver being arranged for energization of its circuits from an alternating current source employing a rectifier, additional means being associated with said rectifier to suppress such harmonics of the fundamental frequincy of said energizing source which are discernible by the detector of the short wave receiver.

And still another object of the present invention is to provide for use with a short wave receiver employing a screen grid detector utilizing regeneration control means in the screen circuit, an arrangement for energizing the circuits of said receiver from an alternating current power line source, said arrangement including a double wave rectifier circuit and a succeeding filter circuit, there being buffer capacities utilized in the anode circuits of the rectifier to suppress ultra-high harmonics of the fundamental frequency of said source.

Still other objects of the present invention are to improve generally the simplicity and efficiency of short wave radio receivers, and to particularly provide a short wave radio receiver, adapted for operation with wave lengths substantially below a hundred meters which is not only reliable in operation, but economically manufactured and assembled.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which I have indicated diagrammatically one circuit organization whereby my invention may be carried into effect.

In the drawing,

Fig. 1 diagrammatically shows a circuit embodying the present invention;

Fig. 2 is a graphical representation of the operation of the harmonic suppressing means used in connection with the power rectifier.

Referring to the accompanying drawing there is shown in Fig. 1, in purely diagrammatic fashion, an arrangement for receiving short waves within a wave length range of the order of 15 to 100 meters inclusive. The receiver, in Fig. 1, comprises any well known type of signal energy collecting means, such as a grounded antenna circuit A, G. The collecting means is coupled, as at M, to the input circuit of a stage of tuned radio frequency amplification which includes a screen grid tube 1. The input electrodes of the tube are connected to a resonant circuit including a variable condenser 2 adapted to tune the radio frequency amplification stage to the desired short wave frequency.

The cathode of the tube 1 includes the usual grid-biasing resistor 3 having a value of about 450 ohms. The resistor is shunted by a radio frequency by-pass condenser 4 having a value of about 0.6 micro-farads. The screen circuit of the tube includes a resistor 5, having a value of about 450 ohms, a radio frequency by-pass capacity 6, of about the same magnitude as the capacity 4, it being connected between the positive leg of the cathode and the screen element.

A conductor 7 provides positive potential for the screen element of tube 1, the conductor 7 being connected to an appropriate tap 8 on any well known type of voltage divider resistor 9 disposed in the power supply circuit. It will be noted that the conductor 7 is connected to a point on the resistor 9 such that a potential of 90 volts is applied to the screen element of tube 1. The anode of the screen grid tube 1 has potential applied to it through a path which includes a conductor 10, a coil 11, a conductor 12 and a conductor 13. The conductor 13 is connected to a tap 14 on the divider 9 such that a potential of about 135 volts is applied to the anode of screen grid tube 1.

A radio frequency by-pass capacity 15 is connected between the junction of conductor 12 and coil 11 and ground. The coil 11 is inductively coupled with the coil 16 disposed in the input circuit of the detector stage of the receiver, the detector stage including a screen grid tube 17. A variable condenser 18 is utilized for tuning the resonant input circuit of the detector stage to the same frequency to which the input circuit of the amplifier tube 1 has been tuned. The usual series capacity 19 and grid leak resistor 20 are provided in the grid circuit of tube 17 to provide detection. The screen element of the tube 17 is connected through conductors 21 and 22, in series with the inductance coil 11, there being a fixed capacity 23, of about 0.01 micro-farads disposed in series in the conductor 22.

Potential is applied to the screen element of tube 17 through a path which includes the conductor 21, a fixed resistor 24, having a magnitude of about 30,000 ohms, the variable contact member 25, a resistor 26 having a value of about 50,000 ohms, and the conductor 27, it being noted that one terminal of the resistor 26 is grounded. The conductor 27 is connected to a tap 28 on the voltage divider 9 such that a potential of 45 volts can be applied to the screen element of detector tube 17.

The anode of the detector tube has potential applied to it through a path which includes a coil 29, a resistor 30 having a value of about 0.1 megohms, conductor 31, and conductor 13, the latter conductor being connected to tap 14 to provide a potential of about 135 volts. A radio frequency by-pass capacity 32 having a value of about 0.00015 micro-farads is connected between the screen element and anode of tube 17. The output of detector tube 17 is impressed upon the input of any well known type of audio frequency amplifier, through a conductor 33, and a conductor 34.

The audio frequency amplifier can be of any type well known to those skilled in the art, and for example, may include one, or more, stages of audio frequency amplification embodying single tubes, and a final power amplifier embodying a push pull stage. However, since the amplifier does not comprise the present invention, it need not be described in any further detail, except to point out that the output of the audio frequency amplifier may be utilized in any well known manner, as by a loud speaker, or head phones, or any other desired audible, and even visual, reproducer.

The coil 11 has a dual function according to the present invention. It serves to transfer amplified signal energy from the anode circuit of the screen grid tube 1 to the resonant input circuit of the detector tube 17, it being understood that the coils 11 and 16 are inductively coupled. The manner of coupling the coils 11 and 16 is such that optimum energy transfer with selectivity is secured, and these coils are preferably interwound to provide this optimum condition.

The coil 11, also, comprises a feed-back path for energy transferred from the anode circuit of the detector tube 17 to the input circuit of the tube. In other words, the detector stage is regenerative, the regeneration being secured through a path which includes the coil 11. It will, therefore, be seen that the latter functions as the primary coil of interstage transformer and simultaneously as a feed-back coil in a regenerative detector stage.

According to the present invention, regeneration in the detector stage is regulated in a novel manner, the regulation being secured by means of a variable impedance in the screen circuit of the detector tube 17. Instead of employing devices, well known to those skilled in the prior art, disposed in the anode circuit of the detector tube, the present invention utilizes the action of the screen element to control regeneration. That is to say, the potential applied to the screen element of tube 17 is controlled by means of the variable resistor comprising the variable contact 25 and the resistor 26.

By varying the position of the contact member 25 with respect to the resistor 26 reliable and satisfactory control of regeneration is secured. While it is not desired to limit the present invention to any particular theory, the following explanation is given to make clear the manner in which the variable impedance in the screen circuit controls regeneration of the detector stage.

Regulation by the conventional variable tickler method cannot be used because changing the spacing of the tickler, changes the associated tuning condenser 18 setting excessively at short waves. Hence, the present arrangement is necessary to insure uni-control between the condensers 2 and 18, as well as to promote facility in tuning, and to permit definite and reproducible logging. By using a fixed tickler, the regeneration is controlled by changing the gain on the tube 17 by varying the screen voltage as described above, through a path including condenser 32, lead 21, condenser 23, lead 22, fixed tickler 11, fixed condenser 15 to ground. Condenser 32 has been added to augment the self-capacity of the tube existing between plate and screen. This increases the regenerative action immensely. Choke 29 confines the radio frequency energy to its proper path.

In adapting the present short wave receiver for use in connection with an alternating current power line source, a double wave rectifier 35 is usually employed. As is well known the anodes of the rectifier are connected to opposite terminals of the secondary coil 36 of the power transformer 37, the primary coil of the latter being connected to the source of alternating current S, in this case the source having a frequency of 60 cycles.

Since the arrangement is well known to those skilled in the art, only the connection between the anodes of the rectifier and the power supply circuit are shown. The mid-point 38, of the secondary 36, is connected through a conductor 39 to the grounded terminal of the voltage divider 9, while one side of the cathode of the rectifier 35 is connected through a conductor 40 to the high potential terminal of the voltage divider 9.

The usual filter circuit comprising a plurality of shunt capacities 41, and series chokes 42 are utilized to suppress the relatively low harmonics of the fundamental frequency of the source S. Merely by way of illustration, and not by way of limitation, it is pointed out that the filter capacity 41 adjacent to the rectifier may have a value of 2 micro-farads, while the succeeding capacities 41′ may each have a value of 3 micro-farads, while each of the capacities 42′ following the last capacity 41′, may have a value of about 1 micro-farad.

Furthermore, each choke 42 may have a value of about 1000 ohms and 20 henries at 100 mils drain. Anode potentials for the audio frequency amplifier tubes may be taken off from point **43**, and the high potential terminal of the voltage divider **9**. Illustrative values of such potentials are given as 250 volts, it being understood that potential is utilized usually for the power amplifier tube, and 180 volts to be utilized on the earlier audio frequency amplifier tubes. However, it is believed that these arrangements are so well known that they need not be described in any further detail.

In Fig. 2 there is graphically shown the operation of the double wave rectifier. As is well known to those skilled in the art, the rectifier **35** functions to convert the alternating wave form into a pulsating uni-directional wave form. For the purpose of explanation alternate half cycles are shown in full lines, while half cycles between the full line half cycles are shown in dotted lines. It was found, by actual experience, that when the short wave receiver disclosed herein was utilized with a power supply circuit as described herein, that due to the sharp cut-off action at each half cycle, hum frequencies were introduced, and detected by the short wave receiver, which frequencies corresponded to ultra-high harmonics of the fundamental frequency of source S.

It can be mathematically demonstrated that the sharp cut-off inherent in a single wave or double wave rectifier action, gives rise to a series of harmonics of the fundamental frequency of the source S. It was found that when a short wave receiver employing a regenerative detector, sufficiently sensitive to detect frequencies corresponding to a range between 15 to 100 meters, was utilized, that ultra-high harmonics produced by the sharp cut-off action of the power rectifier were detected by the regenerative detector, and made discernable. This resulted in annoying hums, and other audible sounds. It should be noted that when the regenerative detector is tuned to its maximum wave length of 100 meters, its detecting signals have a frequency of 3,000,000 cycles. Accordingly, it can be readily seen that the harmonics of the fundamental frequency of source S which would become discernible when the receiver is tuned to 3,000,000 cycles, would have to be of the order of magnitude of at least 50,000.

The usual filtering means employed in power supply circuits can not be employed to suppress the ultra-high harmonics having magnitudes as high as 50,000. Accordingly, it was realized that since these extremely high harmonics arose because of the sharp cut-off action of the rectifier, an arrangement which would change the sharp cut-off action of the rectifier to a gradual slope would eliminate to a very great extent these extremely high harmonics. This change in rectifier action is simply and efficiently secured by disposing a buffer condenser **50** between each anode of the rectifier **35** and ground.

The value of each of these buffer condensers is preferably 0.01 micro-farads. When buffer condensers are employed, as shown in Fig. 1, in connection with the anodes of the rectifier tube, there is secured a gradual slope in the cut-off between alternate half cycles. This is shown in Fig. 2 by the reference numeral **51**. It will, therefore, be seen that by employing buffer condensers from the anodes of the double wave rectifier to ground, hum frequencies about 3,000,000 cycles are effectively eliminated, and that this is secured by changing the sharp cut-off action of the rectifier to a gradual slope.

While I have indicated and described one arrangement for carrying my invention into effect, it will be apparent to one skilled in the art that my invention is by no means limited to the particular organization shown and described, but that many modifications may be made without departing from the scope of my invention as set forth in the appended claims.

What I claim is:

1. A regenerative circuit comprising a space discharge device provided with anode, cathode and grid electrodes having external connections for forming input and output circuits for said device, a screen element in said device, a source of positive potential connected to said screen element, a path between the output and input circuits for feeding energy from the output to the input in regenerative phase, and means comprising a screen potential varying means associated with said screen element for determining the extent of the regenerative feed-back through said path.

2. In combination, a circuit including an electron discharge tube of the screen grid type having input and output circuits, a current source for energizing said tube and a tapered impedance shunted across said source at least a portion of which is included in said output circuit, a feed-back circuit for transferring energy from said output circuit to said input circuit, a resistance shunted across at least a portion of said impedance, a circuit including at least one reactive element connected between the screen element and cathode of said tube and means for variably connecting a point of said last named circuit to said shunting resistance for varying within predetermined limits the potential impressed upon the screen element relative to the cathode of said tube and thereby control the transfer of energy through said feedback circuit.

3. In a regeneratively connected screen grid thermionic tube circuit the step in the method of controlling the degree of regeneration which comprises varying the potential applied to the screen element of the tube and thereby changing the amplifying characteristics of the tube whereby the flow of energy from the output to the input thereof is controlled.

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