Dec. 5, 1939. C. S. ROOT 2,182,678

SILENT TUNING

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Fig. 1.

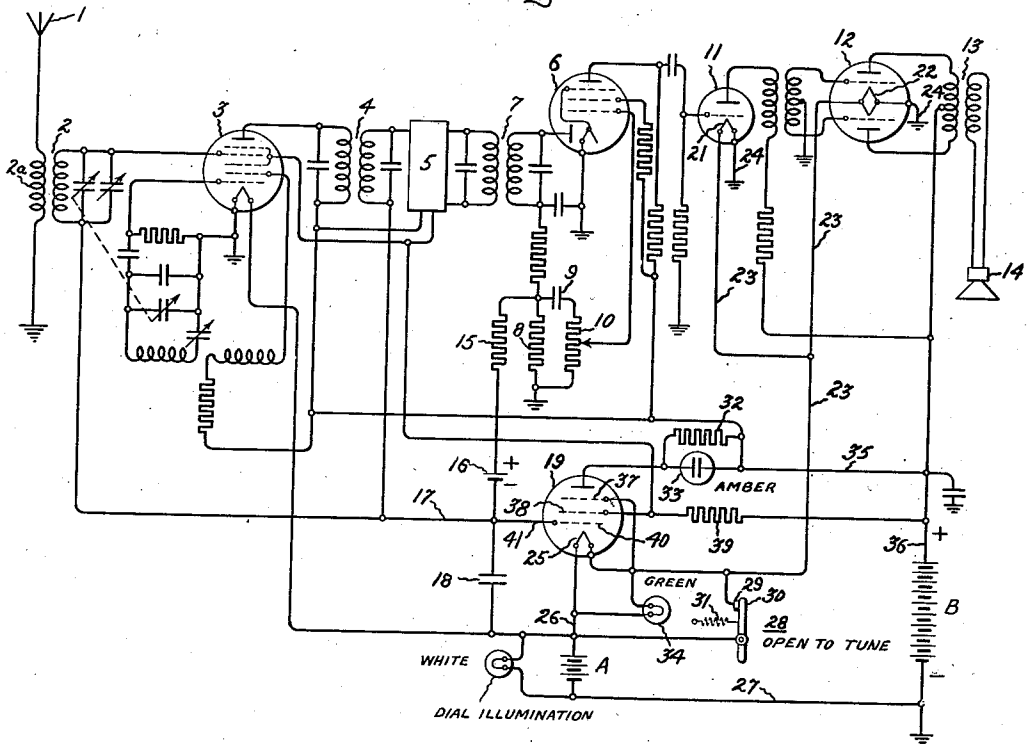
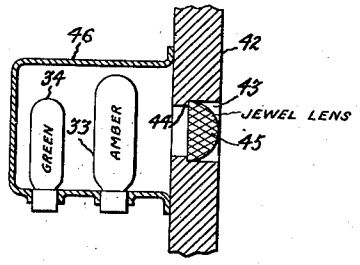


Fig. 2.



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SILENT TUNING

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12 Claims. (Cl. 250—20)

My invention relates to signaling systems and more particularly to high frequency signal receivers. In greater particularity, my invention relates to a combined tuning indicator and silent tuning control for a radio receiver.

In high frequency signaling systems tunable from one signal frequency to another, and particularly in such systems for radio broadcast reception, it is desirable to reduce or even silence the output of the receiver during the period of tuning in order that interstation noises, which are generally of an undesirable and unpleasant character, may be eliminated. Numerous attempts have been made in the past to accomplish this result and several, while partially successful, have resulted either in complicated circuits and apparatus or have resulted in a certain amount of additionally undesirable noise either at the beginning or end or both beginning and end of the silencing period. Accordingly, it is an object of my invention to provide an arrangement whereby silent tuning may be accomplished without the presence of undesirable noises or unpleasant sounds either at the beginning or end or during any portion of the silent period.

A further object of my invention is to attain the desired result by a simple cooperation of apparatus already present in the receiver and without the addition of any expensive or complicated devices.

A still further object of my invention is to provide an arrangement for silent tuning which is simple and inexpensive to manufacture.

An additional object is the provision of a highly sensitive and accurate tuning indicator of the color tuning type controlled by an electron discharge device concurrently and in cooperation with the feature of silent tuning.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents an embodiment of my invention, and Fig. 2 represents an elevation in cross-section of a lamp housing used to position and protect the tuning indicator lamps.

Referring to the drawing, I have illustrated in Fig. 1 a high frequency receiver such as may be used for radio reception wherein an antenna 1 is connected to ground through the primary 2a of a radio frequency transformer 2. Oscillations appearing in the antenna circuit are coupled through the transformer 2 to a pentagrid converter 3 of conventional form. The signal oscillation is changed by the converter to an oscillation of intermediate frequency after which it is transferred through the usual tuned intermediate frequency transformer 4 to the input of an intermediate frequency amplifier conventionally indicated as 5, which may comprise any desired number of stages of amplification. After passing through the intermediate frequency amplifier, the signal oscillations are coupled through a usual tuned intermediate frequency output transformer 7 to a detector constituted by the diode elements of a multi-element electron discharge device 6. The diode rectifier operates into a load resistor 8 and the audio frequency components of the signal oscillation which appear as a pulsating uni-directional electromotive force across the resistor 8 may be coupled through a condenser 9 to a volume control potentiometer 10 and to the control grid of the multi-element tube 6 which provides in conventional manner a first stage of audio frequency amplification. The signal is thereafter further amplified by the audio frequency amplifiers 11 and 12 and is coupled through the output transformer 13 for reproduction by a reproducer 14.

A control voltage for automatic volume control is obtained from the load resistor 8 through a resistor 15, a biasing battery 16, and a conductor 17, the control acting upon any desired number of the radio and intermediate frequency stages of amplification. A condenser 18 and the resistor 15 act to filter from this voltage pulsations of audio and radio frequency. The operation of the automatic volume control circuit is conventional and will not be further amplified since it is so well understood in the art.

In accordance with my invention, means are provided whereby the output of the audio frequency amplifying stages may be reduced or silenced at will during the tuning operation. To this end, the relatively small thermal capacity, and relatively high impedance, filament of an auxiliary electron discharge device 19 is utilized by connecting the filament in series with one side of the supply line which supplies heating current to the filaments 21 and 22 of the electron discharge signal amplifiers 11 and 12. The relatively larger thermal capacity, and relatively low impedance, filaments 21 and 22 of the respective amplifiers 11 and 12 are connected in parallel by conductors 23 and 24 between ground and

one side of the filament 25 of the auxiliary electron discharge device 19, the other side of the filament 25 being connected through a conductor 26, the battery A, and a conductor 27 to ground. Connected across the filament 25 is a circuit interrupting means 28, here shown by way of illustration as of the manually operated switch type, having a pair of contacts 29 and 30 biased by a spring 31 to a normally closed circuit position.

A first source of illumination constituted by a glow discharge device 33 is connected across a resistor 32 positioned in the anode circuit of the device 19. The glow discharge device 33 is comprised by an envelope filled with an attenuated gaseous medium such as neon or argon and has a distinctive color as, for example, the color amber. A second source of illumination constituted by an incandescent lamp 34 is connected across the terminals of the filament 25 and has a distinctive color different from that of the discharge device 33, as for example, the color green. The anode circuit of the auxiliary electron discharge device 19 is completed through the discharge device 33 and its paralleling resistor 32, through conductors 35 and 36 to the positive pole of the battery B which furnishes anode current for the remaining thermionic tubes of the receiver. The discharge device 19 may be of any desired type but is here shown by way of illustration as having in addition to the control grid a suppressor grid 37 connected directly to the filament 25 and a screen grid 38 connected through a voltage reducing resistor 39 to the positive pole of the battery B. The control grid 40 of the device 19 is connected through a conductor 41 to the automatic volume control circuit 17 to receive the same negative biasing voltage which is applied to the control grid of each of the controlled radio and intermediate frequency stages of amplification.

The operation of my tuning indicator and silent tuning control arrangement is as follows: assume for purposes of illustration that the initial condition of the receiver is as shown in the drawing with the switch contacts 29 and 30 biased to closed position under influence of the spring 31. The filament 25 of the device 19 in this initial condition receives no current, the device 19 is inoperative, and any automatic volume control potential which may be impressed upon the grid 40 is ineffective. At the same time, the two sources of illumination 33 and 34 are dark and full filament potential is applied to the filaments 21 and 22 to provide maximum output of the amplifier stages 11 and 12. The receiver is operating in normal manner with full output and with the tuning indicator lamps dark. Tuning may be in the usual way under the guidance of the audible response of the loud speaker.

Suppose at this time that the switch 28 be manually operated against the bias of the spring 31 to open its contacts 29 and 30 so that current now flows from one pole of the battery A through a circuit comprising the filament 25 of the discharge device 19, conductor 23, the filaments 21 and 22 of the respective electron discharge signal amplifiers 11 and 12, conductor 24, and the ground return back to the other pole of the battery A. The introduction of the filament 25, and parallel connected lamp 34, into the series filament circuit operates to reduce the potential drop across, and therefore the temperature of, the filaments 21 and 22 with a resulting decrease in the output of the amplifiers 11 and 12 sufficiently gradual in nature that no transient oscillations are produced and, therefore, no clicks or other unpleasant sounds are heard in the reproducer 14. This reduces the output from the loud speaker to a low value, or silences it, so that tuning of the receiver may be effected without unpleasant sounds therefrom. At the same time, the potential drop across, and therefore the temperature of, the filament 25 increases to cause a flow of electrons to the anode of the discharge device 19. Since the filaments 21, 22 and 25 have a non-linear resistance characteristic, the cooling of the filaments 21 and 22 and the heating of the filament 25 is cumulative so that the switch 28 in effect alternately energizes either the filaments 21 and 22 or the filament 25. Assuming that no signal oscillation is then being received, current begins to flow in the anode circuit of this device sufficient to cause the glow discharge device 33 to become fully luminous. The source of illumination 34, by virtue of its parallel connection with the filament 25, is also luminous. The two sources of illumination 33 and 34 may be physically positioned, as will be described in greater detail hereinafter, to be observed by one tuning the receiving apparatus, the source 33 being arranged in light intercepting relation between the source 34 and the observer in a manner to mask the light of the source 34 whenever the source 33 is operating at its maximum brilliancy. The light from the source 34 becomes more apparent to the observer as the intensity of illumination of the source 33 decreases.

With the receiver operating in this silenced condition, suppose that a signal oscillation is tuned in. An automatic volume control voltage having a value increasing in proportion to the strength of the signal oscillation immediately appears in the control circuit 17 and is impressed through the conductor 41 upon the control grid 40 of the auxiliary electron discharge device 19. The control grid 40 which previously had a small negative bias determined by the battery 16 has an increased negative potential impressed thereon from the volume control circuit 17 which causes the anode current of the discharge device 19 to decrease. The glow discharge device 33 now glows less brightly or may become extinguished depending upon the magnitude of the negative potential in the automatic volume control circuit 17 which, in turn, is dependent upon the magnitude of the received signal oscillations. The intensity of illumination of the device 33 thus provides an indication that the receiver is accurately tuned to the frequency of the signal oscillation, and in cooperation with the source 34 constitutes a color tuning indicator arrangement of great sensitivity and accuracy. The receiver at this time is operating with silenced output, tuning being accomplished by the indications of the combined light sources 33 and 34.

Assume that a signal oscillation has been properly tuned in and it is desired that the signal shall be reproduced by the reproducer 14. The manual force exerted on the switch 28 against the biasing force of the spring 31 is removed and the switch contacts 29 and 30 move to closed circuit position under influence of the spring 31. Potential is immediately removed from the filament 25 and parallel connected lamp 34, whereupon the lamp is extinguished and the devices 19 and 33 are deenergized. At the same time, full operating potential is restored to the filaments 21 and 22 of the respective amplifiers 11 and 12 which heat sufficiently rapidly for all

practical purposes yet sufficiently gradually to avoid a click or other unpleasant sound in the reproducer 14. The receiver now operates at full output with the tuning indicator arrangement deenergized and the tuning lamps dark.

I have shown in Figure 2 the physical positioning of the two light sources 33 and 34 in relation to a light diffusing or diffracting member visible from the front of the receiving apparatus. The control panel 42 of the radio receiver has an apertured window 43 formed therein with a shoulder 44 arranged to seat a diffracting or diffusing member 45, shown here by way of illustration as of a jewel lens type. Supported on the panel 42 and behind the apertured window 43 is a lamp housing 46 which may be cylindrical in shape. The housing preferably supports the sources of illumination 33 and 34 with the source 33 in light intercepting relation between the source 34 and the lens 45. The amber lamp 33 as thus positioned obscures or masks the light from the green lamp 34 so that the jewel lens 45 has a distinct amber color when no signal oscillation is being received by the receiving apparatus. When a signal oscillation is received, however, the decrease in or possible extinguishment of the illumination from the source 33 causes the jewel lens to more nearly appear or to become green in color. It is thus evident that the cooperation of the multiple sources of distinctively colored illumination provides an arrangement for indicating with change of color of the jewel lens whether a station is being received and further indicates by a combination of these colors the relative strength of the received oscillation. The jewel lens 45 is not illuminated when the tuning indicator arrangement is deenergized.

While I have shown two sources of illumination which cooperate during the operation of the tuning indicator arrangement, it is obvious that the source of substantially constant illumination may be dispensed with. Further, while I have shown electronic discharge devices throughout as of the directly heated filament-cathode type, it is to be understood that this is by way of illustration only since it is obvious that the indirectly heated heater-cathode type of electronic discharge device may be used without departing from the spirit of my invention. If discharge devices of the heater-cathode type are employed, it will of course be understood that the cathode heating elements will be connected in the manner of the filamentary cathodes of the discharge devices illustrated.

Although I have shown a particular embodiment of my invention, it will of course, be understood that I do not wish to be limited thereto since different modifications may be made both in the circuit arrangement and in the apparatus employed. I, of course, contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

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

1. The combination, in a tunable radio receiver, of means for amplifying received signals, means to indicate the condition of resonance of said receiver with received signals, means selectively to energize one of said means and simultaneously to deenergize the other of said means, and means included in said first named means for delaying the response of said first named means to changes in its condition of energization whereby the transient audible output of said receiver occasioned by changes in the energization of either said first or said second named means is reduced.

2. The combination, in a tuned radio receiver, of an electron discharge signal amplifier having a heated cathode, means responsive to the intensity of received signals to indicate the condition of resonance of said receiver with said signals, said means including an electron discharge device having a heated cathode, the energizing circuits of said heated cathodes being connected in series across a source of operating potential, and means to shunt one of said energizing circuits.

3. The combination, in a signalling apparatus, of a first electron discharge device having input and output circuits connected to repeat in said output circuit signal potentials supplied to said input circuit, said device having a heated cathode, a second electron discharge device having input and output circuits connected to repeat in said output circuit signal potentials supplied to said input circuit, said second device having a heated cathode, the energizing circuits of said heated cathodes being connected in series across a source of operating potential, and means effectively to render one or the other of said devices operative to repeat said input signal potentials, said last-named means including means to shunt one of said energizing circuits.

4. The combination, in a tuned radio receiver, of a signal channel including an electron discharge device through which signals are transmitted, a tuning indication channel including an electron discharge device, said electron discharge devices having cathode heating circuits connected in series across a source of electromotive force, said electromotive force being insufficient fully to energize both of said cathode heating circuits in series, and means to short circuit one of said cathode heating circuits for fully energizing the other of said cathode heating circuits.

5. The combination, in a radio receiver, of amplifying means including at least one electron discharge device having a heated cathode, a second electron discharge device having a heated cathode, a source of heating current connected to energize the heating circuits of said cathodes in series, and circuit interrupting means normally short-circuiting the cathode heating circuit of said second named discharge device, said interrupting means operating selectively to remove said short circuit for reducing the output of said amplifier while concurrently making operative said second named electron discharge device.

6. The combination, in a signalling apparatus, of a source of signal oscillations, means connected to said source and responsive to signal oscillations therein for producing in an output circuit a control potential, amplifying means associated with said output circuit and including at least one electron discharge device having a heated cathode, a second electron discharge device having an input circuit associated with said output circuit and having an output circuit connected to control an indicator, said last-named discharge device having a heated cathode, a source of current for energizing the heater circuits of said cathodes in series, and means normally short circuiting the cathode heating circuit of said second-named discharge device, said

last-named means operating selectively to remove said short circuit for reducing the output of said amplifying means while concurrently making operative said second-named electron discharge device.

7. The combination, in a receiver of signal oscillations, of a control circuit having a control voltage therein dependent upon the intensity of received signal oscillations, an electron discharge device having a grid, a heated cathode and an anode, said grid being connected to said control circuit to be biased by the control voltage therein, a first source of illumination having a distinctive color connected to be controlled by said anode, a second source of illumination having a distinctive color different from that of said first source, said second source being connected for energization with said heated cathode, a light diffusing member, and housing means for positioning said sources in relation to said member with said first named source in light intercepting relation between said second named source and said light diffusing member.

8. The combination, in a radio receiver, of an audio frequency signal amplifier, said amplifier including an electron discharge device having a relatively low impedance cathode heating circuit, a tuning indicator control device having a relatively high impedance cathode heating circuit, means for connecting said cathode heating circuits in series across a source of electromotive force, and means for alternately energizing said cathode heating circuits, said last-named means including means to short-circuit said high impedance cathode heating circuit.

9. In a signalling apparatus, the combination of a signal amplifier having an electron discharge device included therein, said device having elements including a cathode, a circuit having a non-linear resistance characteristic for energizing said cathode, tuning indication means, means including an electron discharge device having a cathode for controlling the operation of said last-named means in response to a characteristic of signal oscillations supplied to said signalling apparatus, a circuit having a non-linear resistance characteristic for energizing said last-named cathode, and means for rapidly and quietly controlling the output volume of said signalling apparatus, said last-named means including a connection of each of said energizing circuits in series across a source of electromotive force, and means for selectively short-circuiting said last-named energizing circuit.

10. In a signalling apparatus, the combination of a signal amplifier having an electron discharge device included therein, said device having a cathode of relatively large thermal capacity, an energizing circuit for said cathode, a second electron discharge device cathode having a relatively small thermal capacity, an energizing circuit for said last-named cathode, and means for controlling the output volume of said amplifier without disturbing transient oscillations, said last-named means including a connection of said energizing circuits in series across a source of electromotive force, and means for selectively short-circuiting said last-named energizing circuit.

11. A tuning indicator for a radio receiver comprising, in combination, an electron discharge device having input and output circuits and having a cathode energizing circuit, means for supplying to said input circuit a control potential whose magnitude varies with the average intensity of received signal oscillations, a source of substantially constant illumination, a source of illumination whose intensity is controlled by said output circuit in a manner to be changed proportionately to changes in said control potential, means utilizing the concurrent illumination of said sources for indicating the degree of resonance of said receiver with received signal oscillations, and means for simultaneously energizing and de-energizing said device and said sources of illumination, said last-named means including means to short-circuit said cathode energizing circuit.

12. The combination, in a signaling system, of means for tuning said system to a selected operating frequency, means for amplifying signal oscillations, means for visually indicating the accuracy of tuning of said receiver to said selected operating frequency, said last named means being normally deenergized, and means responsive to the energization of said last named means to provide a tuning indication for reducing the amplification of said amplifying means.

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