May 2, 1944. L. J. A. VAN LIESHOUT 2,347,977

RADIO RECEIVER

Filed May 25, 1942

Fig. 1.

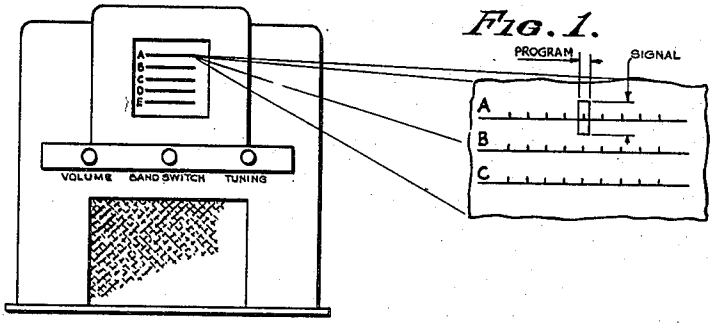


Fig. 2.

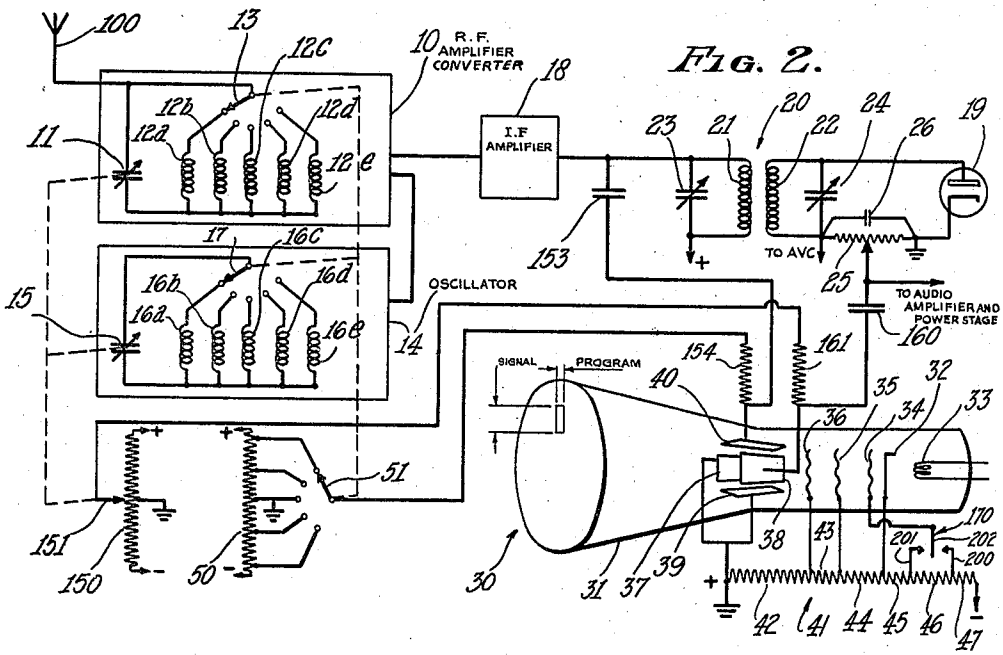


Fig. 3.

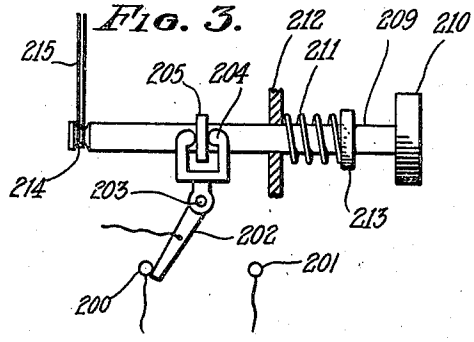
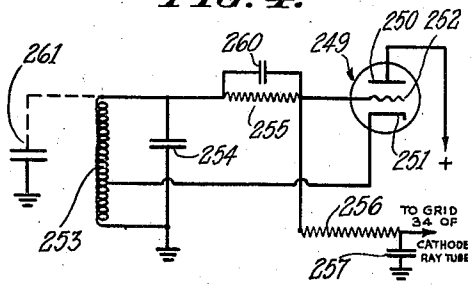


Fig. 4.



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RADIO RECEIVER

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Application May 25, 1942, Serial No. 444,408

9 Claims. (Cl. 250—20)

The present invention relates to improvements in radio receivers, and more particularly to a device for simultaneously indicating visually all the important operating conditions of a radio receiver.

It is an object of the invention to provide a non-mechanical tuning dial for a multi-band radio receiver whereby the frequency band and the frequency to which the radio receiver is tuned is indicated visually without the use of a dial-drive or similar mechanical expedients.

Another object of the invention is to provide a novel arrangement for simultaneously indicating visually, the frequency band and the frequency to which a radio receiver is tuned, whether the receiver is properly tuned, and the intensity of the incoming signal currents.

In some instances it is necessary to make a recording of the program material received. In such cases, to obtain a satisfactory recording, it is essential that the radio receiver be accurately tuned and at the same time the intensity of the program material (the audio intensity) be kept within specified limits.

It is therefore a further object of the invention to provide a novel arrangement by which the intensity of the program material is indicated visually simultaneously with the above referred operating conditions of the radio receiver.

A still further object of the invention is to provide a tuning indicator which is efficient and reliable in operation and which can be assembled in a radio receiver in a simple manner.

These and further objects of the invention will appear as the specification progresses.

In accordance with the invention use is made of a cathode-ray type tube wherein the conditions to be indicated are simultaneously manifested by characteristic displacements and/or variations in the intensity of the electron beam impinging on the screen of the tube. More specifically, by applying suitable voltages derived from the radio receiver, the electron beam of the cathode-ray tube is made to deflect in a vertical direction to predetermined positions corresponding to the "tuning band" to which the receiver is adjusted, and to deflect in a horizontal direction corresponding to the frequency to which the receiver is tuned. Furthermore, by controlling the vertical and horizontal size of the image on the screen of the cathode-ray tube, the intensity of the signalling currents and the intensity of the program material is simultaneously indicated.

The invention will be described in greater detail with reference to the appended drawing forming part of the specification and in which:

Figure 1 is a frontal view of a radio receiver embodying the visual indicating device of the invention.

Fig. 2 is a circuit diagram schematically illustrating the visual indicator of the invention in its use in a radio receiver.

Fig. 3 is a side view partly in cross-section showing a method of controlling the effectiveness of the visual indicator in accordance with a further feature of the invention.

Fig. 4 illustrates a modified arrangement for controlling the effectiveness of the visual indicator during "stand by" periods.

Referring to Fig. 1, the radio receiver shown comprises as a visual indicator, a cathode-ray tube, the fluorescent screen of which is covered with a transparent scale having markings corresponding to the tuning bands and frequencies to which the receiver is adapted to be tuned. The markings for the individual "bands" indicated A, B, C, D, E are arranged vertically with respect to each other and each band is subdivided horizontally to mark the tuning frequencies in conventional manner.

For indicating the tuning band of the receiver, the electron beam of the cathode-ray tube is made to deflect in a vertical direction and to indicate the tuning frequency of the receiver, the beam is made to deflect in a horizontal direction. Simultaneously, the size of the screen image produced by the electron beam is made to vary vertically and horizontally to indicate respectively, the intensity of the signalling currents and the intensity of the program (audio) material. These displacements and/or variations of the electron beam in accordance with the preferred embodiment of the invention have been indicated in Fig. 1 by suitable legends.

The circuit arrangement shown in Fig. 2 illustrates one method by which control voltages may be derived from a radio receiver for deflecting the electron beam of the cathode-ray tube to produce the visual indications above set forth. The circuit illustrated (shown partly in block form and with non-pertinent portions omitted for purposes of simplification) is for a multi-band superheterodyne receiver.

The signal currents received, for example, by an antenna 100, are applied to the tuning circuit of a radio frequency amplifier-converter 10 which includes inductances 12*a*, 12*b*, 12*c*, 12*d* and 12*e* each inductance corresponding to a frequency band of the receiver, and an adjustable tuning condenser 11 for tuning the receiver through each

frequency band. The inductances 12 are selectively placed in circuit by a switch 13 operated by the band-change knob of the receiver. Similarly condenser 11 is adjusted through its range by a suitable tuning knob.

Within the amplifier-converter 10 the signal currents are heterodyned with a locally generated oscillation derived from a variable frequency oscillator which similarly comprises inductances 16*a*, 16*b*, 16*c*, 16*d* and 16*e* corresponding to the tuning bands of the receiver and an adjustable tuning condenser 15 for adjusting the oscillator frequency through its tuning range. A switch 17 ganged to the switch 13, selectively places the inductances 16 in circuit. Similarly, and in accordance with known practice, the condenser 15 is ganged to and is simultaneously adjusted with the condenser 11.

The heterodyned signal voltage derived from the amplifier-converter 10 is supplied through an intermediate frequency (I. F.) fixed tuned amplifier 18 to a transformer 20 having its primary winding 21 connected across the output of the I. F. amplifier and its secondary 22 connected to a demodulator circuit for deriving the program material from the signal currents. Semi-adjustable condensers 23 and 24 are connected across the primary and the secondary windings respectively of the transformer 20 to tune these windings to the I. F. frequency. The demodulation of the signal currents is effected by a diode rectifier 19 connected across the secondary 22 of the transformer 20 with the interposition of a load resistor 25. A condenser 26 shunts the resistor 25 for filtering the I. F. components from the output voltage of the demodulator. As shown the resistor 25 is of the potentiometer type and thereby serves as a volume control for the receiver, the audio voltages being obtained from an adjustable tapping of the potentiometer and are supplied to a suitable amplifier and loud-speaker arrangement (not shown).

For the visual indication of the tuning band, tuning frequency, signal intensity and audio intensity I provide a cathode ray tube 30 comprising an envelope 31, a cathode 32 serving as a source of the electron beam, a cathode heater 33, a control grid 34, and focussing electrodes 35 and 36. For deflecting the electron beam in a horizontal direction there are provided horizontal deflecting electrodes 37 and 38, and for controlling the path of the electron stream in a vertical direction, vertical deflecting electrodes 39 and 40.

The direct current voltage supply for the tube may be derived from a potentiometer 41 connected to a suitable voltage source (not shown) and comprising individual resistor elements 42, 43, 44, 45, 46 and 47 connected in series. As shown, deflecting plates 37 and 39 are connected to the positive end of resistor 42 and are maintained at ground potential with respect to the other electrodes of the tube by being connected to the chassis of the radio receiver. Focussing electrode 35 is connected to the junction of resistors 43 and 44, focussing electrode 36 is connected to the junction of resistors 42 and 43 and cathode 32 is connected to the junction of resistors 44 and 45.

Connections are provided at the junction of resistors 45—46 and 46—47 for purposes later to be more fully pointed out.

In accordance with the embodiment shown in Fig. 2 the cathode-ray tube 30 is made to indicate the frequency band and the tuning frequency of the radio receiver by applying to the deflecting electrodes 37—38 and 39—40 voltages proportional to these operating conditions of the radio receiver. The voltage for deflecting the electron beam vertically and thereby indicating the frequency band of the receiver, is obtained from a resistor 50 connected to a suitable voltage source (not shown). Resistor 50 is grounded at its electrical center and is provided with tappings corresponding in number to the number of the frequency bands of the receiver. By means of a switch 51 the deflecting electrode 40 is selectively connected to the tappings of resistor 50 and is made to assume predetermined voltage differences relative to electrode 39. In practice the switch 51 is ganged to the band-change switches 13 and 17 and the vertical deflection of the electron beam is simultaneously effected by the band-change knob of the receiver.

The voltage for deflecting the electron beam in a horizontal direction to thereby indicate the tuning frequency of the receiver, is obtained from a potentiometer 150 connected to a suitable voltage source (not shown) and grounded at its electrical center. By varying the position of the arm 151 of the potentiometer simultaneously with the tuning condensers 11 and 15 by means of a common control, a progressively negative or positive potential is applied to the deflecting electrode 38 relative to the electrode 37 causing the beam to move in a continuous manner across the screen of the cathode-ray tube.

For indicating the intensity of the signal source and the proper tuning of the receiver, a voltage proportional to the I. F. voltage is applied to the vertical deflecting electrode 40 relative to the electrode 39, said voltage being derived from a connection to the high-potential side of the primary 21 of I. F. transformer 20 and being applied to electrode 40 through an isolating condenser 153. A resistor 154 is connected in the lead between the electrode 40 and the arm of switch 51 and serves to prevent short-circuiting of the I. F. voltage to ground through the resistor 50. As will readily appear, the I. F. voltage appearing at the input to the transformer 20 is proportional to both the signal strength of the signal current and the proper tuning of the receiver and these operating conditions are indicated by the length of the vertical line traced by the electron beam on the screen of the cathode-ray tube whereby the longer the line the greater the signal strength and/or the more correct the tuning of the receiver.

For indicating the intensity of the audio output of the receiver a voltage proportional to the audio voltage is applied to the horizontal deflecting electrodes 37—38, said voltage being obtained, for example, by connecting the electrode 38 to the movable arm of the potentiometer 25 through an isolating condenser 160. Short-circuiting of the audio voltage to ground through the potentiometer 150 is prevented by means of resistor 161 connected in the lead between the electrode 38 and the arm of the potentiometer 150.

In accordance with a further feature of the invention the cathode-ray tube is made effective only during tuning periods and remains ineffective during "stand-by" periods i. e. during periods when observation of the operating conditions of the receiver is unnecessary. More particularly, during periods of observation a control voltage of relatively low negative value with respect to the cathode 32 is applied to the control grid 34. During "stand-by" periods a control grid voltage of relatively large negative value relative to the cathode is applied to the grid 34 thereby effec-

tively blanketing the electron beam or at least greatly diminishing its intensity during such stand-by periods. For this purpose the control grid 34 is selectively connected to one or the other of the junctions between resistors 45—46 and 46—47 by a switch 170.

Switch 170 may comprise (see Fig. 3) fixed contact members 200 and 201 connected to the junction of the resistors 45—46 and 46—47 and a movable switch arm 202 connected to the control grid 34. As shown, arm 202 is pivoted at 203 and at its driven end is provided with a yoke 204.

Switch 170 is actuated by axial displacement of the tuning knob 210 of the radio receiver said displacement being transmitted to the switch by a shaft 209 to which the knob is affixed and a collar 205 positioned on the shaft and engaging the yoke 204.

In operation, the switch is normally maintained in the "stand-by" position at which time the arm 202 is connected to contact 200 and the electron beam is blanketed by the relatively large negative voltage so applied to the control grid 34 of the cathode-ray tube from the junction of resistors 46—47.

To apply a relatively low negative potential to the control grid during the tuning periods, the arm 202 is connected to contact 201 said connection being effected by axially displacing the tuning knob simultaneously with the rotation thereof incidental to the tuning operation.

For maintaining the switch in its normal "stand-by" position there is provided on shaft 209 a compression spring 211 one end of which abuts against a fixed support 212 secured to the chassis of the radio receiver and the other end of which abuts against a collar 213 provided on the shaft.

Shaft 209 is formed with an annular groove 214, within which is retained a driving cord 215 for actuating the tuning condensers 11 and 15 and the potentiometer 150.

In Fig. 4 there is shown another method of making the cathode-ray tube effective during tuning periods and ineffective during "stand-by" periods. In the method shown in Fig. 4 an oscillator supplies a negative voltage to the control grid of the cathode-ray tube during stand-by periods thereby blanketing the electron beam during such periods. The oscillator shown comprises a discharge tube 249 having an anode 250, a cathode 251 and a grid electrode 252 connected in feed-back relationship to a fixed tuned resonance circuit comprising an inductance 253 and a condenser 254. A grid leak 255 shunted by a grid condenser 260 is connected in series with the tuning inductance and the grid electrode 252 and provides the normal operating negative bias voltage of the oscillator which bias voltage is applied to the control grid 34 of the cathode-ray tube through a resistance-capacity filter 256—257. Connected to the high potential side of the resonance circuit 253—254 is a metal knob 261 serving for the tuning of the radio receiver.

The operation of the control system shown in Fig. 4 is as follows:

During "stand-by" periods, the oscillator developes a relatively large negative voltage at the grid 252. This voltage is applied to the control grid 34 thereby blanketing the electron beam of the cathode-ray tube. However, when the tuning knob 261 is grasped incidental to adjusting the frequency of the radio receiver, the hand capacity so introduced, so loads the oscillator that it ceases operation. Immediately thereupon, the negative voltage developed at the grid 252 is diminished and consequently the negative voltage applied to the control grid 34 is also diminished thereby permitting a greater intensity of the electron beam of the cathode-ray tube. When the receiver has been tuned properly to the desired frequency and the tuning knob is released, the oscillator is again made operative and a large negative voltage is again applied to the control grid of the cathode-ray tuning indicator.

While I have described my invention in a specific embodiment and by a specific example, I do not wish to be limited thereto for obvious modification will appear to those skilled in the art without departing from the spirit and scope of the invention.

What I claim is:

1. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, and electron beam producing elements, means to deflect the electron beam along one axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver and means to deflect the electron beam along an axis perpendicular to said first axis in an amount corresponding to the tuning frequency of the radio receiver, said first means being actuated simultaneously with means to change the tuning band of the receiver and said second means being actuated simultaneously with means to tune the radio receiver through its frequency bands.

2. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, an electron beam producing elements and deflecting electrodes for deflecting the beam in a vertical and horizontal manner, a voltage source connected to the vertical deflecting electrodes and a voltage source connected to the horizontal deflecting electrodes, means to vary the voltage applied to the vertical deflecting electrodes in an incremental manner to deflect the electron beam along the vertical axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver, and means to vary the voltage applied to the horizontal deflecting electrodes in a continuous manner to deflect the electron beam along the horizontal axis of the fluorescent screen in a continuous manner, said first voltage varying means being actuated simultaneously with means to change the tuning band of the receiver and said second voltage varying means being actuated simultaneously with means to tune the radio receiver through its frequency bands.

3. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, an electron beam producing elements and deflecting electrodes for deflecting the beam in a vertical and horizontal manner, a voltage source connected to the vertical deflecting electrodes and a voltage source connected to the horizontal deflecting electrodes, means actuated simultaneously with means to change the tuning band of the receiver to vary the voltage applied to the vertical deflecting electrodes in an incremental manner to deflect the electron beam along the vertical axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver, means actuated simultaneously with means to tune the radio receiver through its frequency bands to vary the voltage applied to the horizontal deflecting electrodes in a continuous

manner to deflect the electron beam along the horizontal axis of the fluorescent screen in a continuous manner, and means to superimpose on one of said deflecting voltages a voltage proportional to the amplitude of the signalling currents of the radio receiver.

4. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, an electron beam producing elements and deflecting electrodes for deflecting the beam in a vertical and horizontal manner, a voltage source connected to the vertical deflecting electrodes and a voltage source connected to the horizontal deflecting electrodes, means actuated simultaneously with means to change the tuning band of the receiver to vary the voltage applied to the vertical deflecting electrode in an incremental manner to deflect the electron beam along the vertical axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver, means actuated simultaneously with means to tune the radio receiver through its frequency bands to vary the voltage applied to the horizontal deflecting electrodes in a continuous manner to deflect the electron beam along the horizontal axis of the fluorescent screen in a continuous manner, means to superimpose on the vertical deflecting voltage a voltage proportional to the amplitude of the signalling currents of the radio receiver, and means to superimpose on the horizontal deflecting voltage a voltage proportional to the audible output of the radio receiver.

5. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, an electron beam producing elements and at least two pairs of relatively perpendicular deflecting elements, means actuated simultaneously with means to change the tuning band of the receiver for deflecting the electron beam along one axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver, means actuated simultaneously with means to tune the radio receiver through its frequency bands for deflecting the electron beam along an axis perpendicular to said first axis in an amount corresponding to the tuning frequency of the radio receiver, and means for selectively blanketing the electron beam during stand-by periods and rendering the system substantially ineffective during said periods.

6. A visual indicating system for a multi-band radio receiver, comprising a cathode-ray tube having a fluorescent screen, an electron beam producing elements, a control grid for the electron beam and relatively perpendicular deflecting elements, means actuated simultaneously with means to change the tuning band of the receiver for deflecting the electron beam along one axis of the fluorescent screen in incremental steps corresponding to the tuning bands of the radio receiver, means actuated simultaneously with means to tune the radio receiver through its frequency bands for deflecting the electron beam along an axis perpendicular to said first axis in an amount corresponding to the tuning frequency of the radio receiver, a voltage source for applying a substantially large negative potential to said control grid to selectively blanket the electron beam during stand-by periods, and means actuated by the tuning member of the radio receiver to diminish the negative potential of the voltage applied to the control grid during tuning periods of the radio receiver.

7. In the method of the operating a visual indicating system for visually indicating operating conditions of a radio receiver by means of a cathode ray tube, selectively making the system effective during tuning periods of the radio receiver and blanketing the electron beam of the cathode-ray tube during stand-by periods.

8. In a visual indicating system for visually indicating operating conditions of a radio receiver by means of a cathode-ray tube having an electron beam producing elements, a control electrode for the electron beam and relatively perpendicular deflecting elements, a voltage source, a switch member actuated simultaneously with means to tune the radio receiver through its tuning bands, said switch member selectively applying a relatively high negative potential from the voltage source to the control electrode in its non-actuated position and applying a substantially low negative potential to the control electrode in its actuated position.

9. In a visual indicating system for visually indicating operating conditions of a radio receiver by means of a cathode-ray tube having electron beam producing elements, a control grid and relatively perpendicular deflecting elements, means to selectively make the system effective during tuning periods of the radio receiver and to blanket the electron beam during stand-by periods, said means comprising a source of oscillations including means to develop a substantially high negative voltage, means to apply the negative voltage to the control grid of the cathode-ray tube, and means associated with means for tuning the radio to render said source of oscillations inoperative during tuning periods.

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