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H. M. WAGNER

2,122,267

TUNING INDICATOR CIRCUITS

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Fig. 1

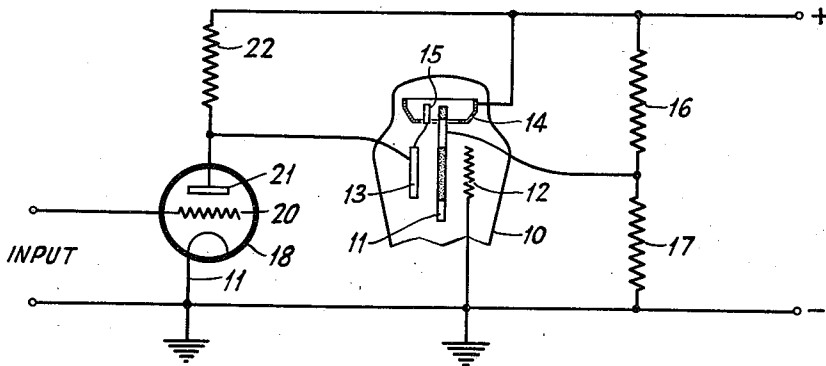


Fig. 2

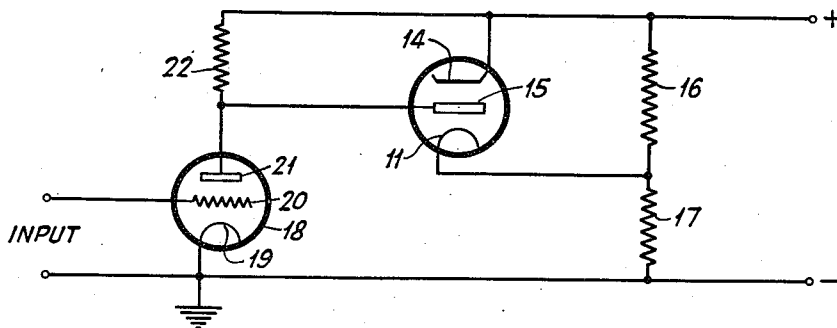
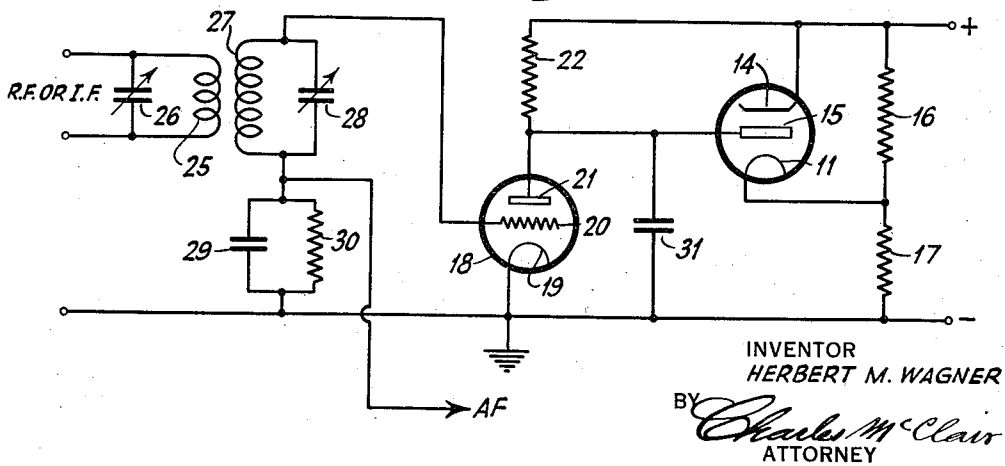


Fig. 3



UNITED STATES PATENT OFFICE

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TUNING INDICATOR CIRCUITS

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6 Claims. (Cl. 250—40)

My invention relates to circuits incorporating visual voltage or tuning indicators of the electron discharge type and particularly suitable for radio circuits.

5 One embodiment of an electron discharge device useful as a tuning indicator is described in my previous Patent 2,051,189, allowed August 18, 1936 and assigned to the Radio Corporation of America, and comprises an envelope having with-
10 in it a straight thermionic equipotential cathode provided with two separate emitting sections, one of which is surrounded by amplifier elements which comprise a control grid and anode, and the other of which is surrounded by the tuning indicator elements of the tube consisting of a
15 straight control electrode parallel to the cathode and a dish-shaped anode or target coated on its inside surface with fluorescent material and concentric with and surrounding the cathode and the control electrode. In operation electrons flow
20 from the cathode to the fluorescent anode with sufficient velocity to bombard the fluorescent anode and render it luminous. The fluorescent portion gives the appearance of a ring of light
25 broken by a dark space or electron shadow cast by the control electrode, the size of the shadow angle being dependent upon the bias on the control electrode. The control electrode is connected to the amplifier anode and the tube so
30 connected into a radio receiving circuit that when the circuit is tuned to resonance with an incoming signal then the luminous portion of the plate is of predetermined width. The device is to advantage so connected that when the circuit
35 is tuned to resonance the luminous portion of the anode of the tuning indicator portion is of maximum width and the dark portion of minimum width, preferably the entire anode becoming fluorescent and the dark portion disappearing.

40 Because of the fact that the cathode is common to both the amplifier portion and the tuning indicator portion of the tube, and the control electrode of the tuning indicator portion of the tube is connected to the amplifier anode, the
45 control electrode cannot become negatively biased with respect to the cathode when used in the conventional circuit but is always at some positive potential with respect to the cathode. This limits the maximum area or angle of shadow
50 cast by the control rod on the fluorescent anode of the tuning indicator portion of the tube and thus limits the usefulness of the tube over that which it would otherwise have if it were possible to increase the angle of shadow cast by the control electrode.

The object of my invention is to provide a visual voltage or tuning indicator of the type described and a circuit therefor in which the shadow angle range may be increased and thus the usefulness of the indicator increased.

5 The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims, but the invention itself will best be understood by reference to the following description taken in connection with the accompanying drawing in which
10 Figure 1 is a diagrammatic representation of a tube and circuit embodying my invention, and Figures 2 and 3 are modifications of the invention disclosed in Figure 1.

15 Referring to Figure 1 the visual voltage or tuning indicator comprises an envelope 10 containing cathode 11, the bottom portion of which is surrounded by grid 12 and anode 13. The upper portion comprises the indicator portion
20 and includes the fluorescent anode 14 and control rod 15 connected to the anode 13. This device is of the form shown and described in Patent 2,051,189 referred to above. The amplifier portion of the tube is rendered inoperative by connecting the control grid 12 to ground so that no
25 current flows in the anode circuit. In order to place the cathode 11 above ground potential a separate battery or a biasing resistor may be connected between ground and the cathode although I prefer to use a voltage divider such as
30 shown in the drawing and comprising resistors 16 and 17 connected across the source of anode voltage supply. The amplifier which impresses the amplified voltage input between the cathode
35 11 and anode 13 connected to control rod 15 comprises the triode having envelope 18 containing cathode 19, control grid 20 and anode 21. A resistor 22 is connected between the anode 21 and the fluorescent anode 14 to provide a difference
40 of potential during operation between the control rod 15 and anode 14, as will be described, to vary the angle of shadow on the fluorescent anode. The input is impressed between the control grid 20 and cathode 19 of the amplifier tube
45 18. It will thus be seen that the amplifier portion of the tube has in effect been replaced by a second amplifier, the anode 13 serving merely as a connection between the control grid 15 and the anode 21 of the auxiliary amplifier 18. While
50 the circuit described is intended to operate primarily from the rectifier circuit for providing automatic volume control voltages in radio receiving circuits, it is not limited to such application.

The operation of the circuit is as follows: With no signal on the grid or with grid 20 of the amplifier at cathode potential current will flow through resistor 22 causing a drop across the resistor so that the voltage on anode 21 and control rod or electrode 15 drops with respect to the fluorescent anode 14 connected directly to the positive terminal of the anode voltage supply. Under these conditions the shadow cast by the control grid is at a maximum. Because the cathode 11 is above ground potential and because the circuit constants are so chosen that the drop across tube 18 is less than the voltage drop across resistor 17 the control rod 15 is at a negative potential with respect to the cathode 11. Under these conditions the shadow which is cast is considerably greater than it would otherwise be if the cathode were at ground potential since under these conditions the control electrode 15 would be at some positive potential with respect to the cathode. As the negative bias on the control grid 20 of the amplifier is increased the current through the resistor 22 decreases so that the difference of potential between control rod 15 and fluorescent anode 14 decreases and the shadow angle decreases. At cut-off the anode 21, control rod 15 and fluorescent anode 14 are at substantially the same potential since there is then no current and no drop in resistor 22 except for the small current flow and voltage drop due to the control electrode current. Under these conditions the fluorescent pattern or ring of light on the fluorescent anode just closes so that the anode is completely fluorescent. By making it possible for the control rod to be both negative and positive with respect to the cathode, the shadow angle is considerably increased thus increasing the usefulness of the indicator device. While particularly suitable for application to tuning indicators in radio receiving circuits its application as a voltage indicator which draws no power from the measured circuit is apparent.

It is possible to provide the tuning indicator portion in a separate envelope as a separate tube. That is, only that portion of the tube shown in Figure 6 of Patent 2,051,189, referred to, may be incorporated in a single envelope and a separate amplifier provided outside of the envelope. This arrangement is shown in Figure 2 where the circuit and operation are substantially the same as that shown in Figure 1.

In Figure 3 is shown a circuit in which the triode amplifier performs both the function of the detector and the amplifier tube, thereby eliminating a separate amplifier tube. In this arrangement rectification takes place between the cathode and grid of the amplifier for providing a voltage to be applied to the audio frequency amplifier. The radio frequency or intermediate frequency input circuit comprising the inductance 25 and variable condenser 26 is connected to the tuned circuit comprising inductance 27 and variable condenser 28, which is connected between the grid 20 of the amplifier and in series with the filter comprising condenser 29 and resistor 30, the rectified voltage drop which appears across this resistor being applied to the audio frequency amplifier. Radio and audio currents which find their way to the anode 21 are by-passed to ground by means of by-passing condenser 31. The operation of the amplifier and tuning indicator tube are otherwise the same as in Figures 1 and 2.

As an example in the circuit shown in Figure 1 I have used for the resistors 16 and 17 20,000 ohms, for the resistor 22 1 megohm and for the

input amplifier tube a type RCA-76. Very satisfactory results were obtained with this arrangement.

While I have indicated the preferred embodiments of my invention of which I am now aware and have also indicated only one specific application for which my invention may be employed, it will be apparent that my invention is by no means limited to the exact forms illustrated or the use indicated, but that many variations may be made in the particular structure used and the purpose for which it is employed without departing from the scope of my invention as set forth in the appended claims.

What I claim as new is:

1. A circuit comprising an electron discharge device having an envelope, a cathode within said envelope for emitting electrons, an anode surrounding said cathode and having its interior surface coated with a fluorescent material for receiving electrons from said cathode to produce a luminous annular shaped pattern on said anode, a control electrode positioned between said anode and said cathode for determining the area of fluorescent surface of the anode reached by the electrons from said cathode, a source of voltage the positive terminal of which is connected to said anode, a resistor connected between the anode and control electrode, a variable resistance comprising an electron discharge device connected in series with said first resistor and between the negative side of said source of voltage and said control electrode and means between the cathode and the negative side of said source of voltage supply for raising said cathode to a positive potential with respect to the negative side of said source of voltage supply.

2. A circuit comprising an electron discharge device having an envelope, a cathode within said envelope for emitting electrons, an anode having its surface coated with a fluorescent material for receiving electrons from said cathode to produce a luminous pattern on said anode, a control electrode positioned between said anode and said cathode for determining the area of fluorescent surface of the anode reached by the electrons from said cathode, a source of voltage the positive terminal of which is connected to said anode, a resistor connected between the anode and control electrode, a variable resistance connected in series with said first resistor and between the negative side of said source of voltage and said control electrode and means between the cathode and the negative side of said source of voltage supply for raising said cathode to a positive potential with respect to the negative side of said source of voltage supply.

3. A circuit comprising an electron discharge device having an envelope, a cathode within said envelope for emitting electrons, an anode surrounding said cathode and having its interior surface coated with a fluorescent material for receiving electrons from said cathode to produce a luminous annular shaped pattern on said anode, a control electrode positioned between said anode and said cathode for determining the area of fluorescent surface of the anode reached by the electrons from said cathode, a source of voltage the positive terminal of which is connected to said anode, a resistor connected between the anode and control electrode, an electron discharge device having a control grid and connected in series with said resistor and between the negative side of said source of poten-

tial and said control electrode and a resistor connected between the cathode and the negative terminal of said source of voltage supply.

4. A circuit comprising an electron discharge
5 device having an envelope, a cathode within said envelope for emitting electrons, an anode surrounding said cathode and having its interior surface coated with a fluorescent material for
10 receiving electrons from said cathode to produce a luminous annular shaped pattern on said anode, a control electrode positioned between said
15 anode and said cathode for determining the area of fluorescent surface of the anode reached by the electrons from said cathode, a source of voltage the positive terminal of which is connected to the anode, a resistor connected between the anode and control electrode, a thermionic
20 device connected in series with said resistor and having a control grid between the negative side of said source of voltage and said control electrode, and a voltage divider connected across
25 said source of voltage, the cathode being connected to said voltage divider to place said cathode at positive potential with respect to the negative terminal of said voltage supply.

5. A circuit including an electron discharge device having an envelope, a straight thermionic cathode within said envelope having two separate emitting sections thereon, a grid and anode surrounding one of said emitting sections and a
30 control electrode adjacent the other emitting section electrically connected to and supported by said anode, and a second anode concentric with and positioned around the other emitting section of the cathode and said control electrode
35 and having a fluorescent coating on the interior thereof, a source of voltage supply the positive terminal of which is connected to the second anode, means connected between the negative
40 side of said source of voltage supply and said cathode for applying a positive potential to said

cathode with respect to the negative side of said source of voltage supply, and a connection between the grid and the negative terminal of said voltage supply whereby said grid is at a negative potential with respect to said cathode
5 normally biasing the portion of the tube containing the grid to cut-off, a resistor connected between the second anode and the first anode, and a grid controlled electron discharge device connected between the first anode and the negative
10 terminal of said source of voltage supply.

6. A circuit comprising an electron discharge device having an envelope, a cathode within said envelope for emitting electrons, an anode surrounding said cathode and having its interior
15 surface coated with a fluorescent material for receiving electrons from said cathode to produce a luminous annular shaped pattern on said anode, a control electrode positioned between said anode and said cathode for determining the
20 area of fluorescent surface of the anode reached by the electrons from said cathode, a source of voltage the positive side of which is connected to the anode, a resistor connected between the anode and control electrode, an electron discharge
25 device having a cathode, grid and anode connected in series with said resistor, said grid controlled electron discharge device being connected between the negative side of said source of potential and said control electrode and means
30 for applying a positive voltage between the cathode and the negative side of said source of voltage supply, an input circuit connected between the grid and cathode of the electron discharge device and comprising a tuned circuit and a resistor
35 connected in series, and a by-passing condenser connected between the anode of said electron discharge device and the negative terminal of said source of voltage supply.

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