May 20, 1941. H. HEINS 2,243,034

FLUORESCENT INDICATING DEVICE

Filed June 3, 1937

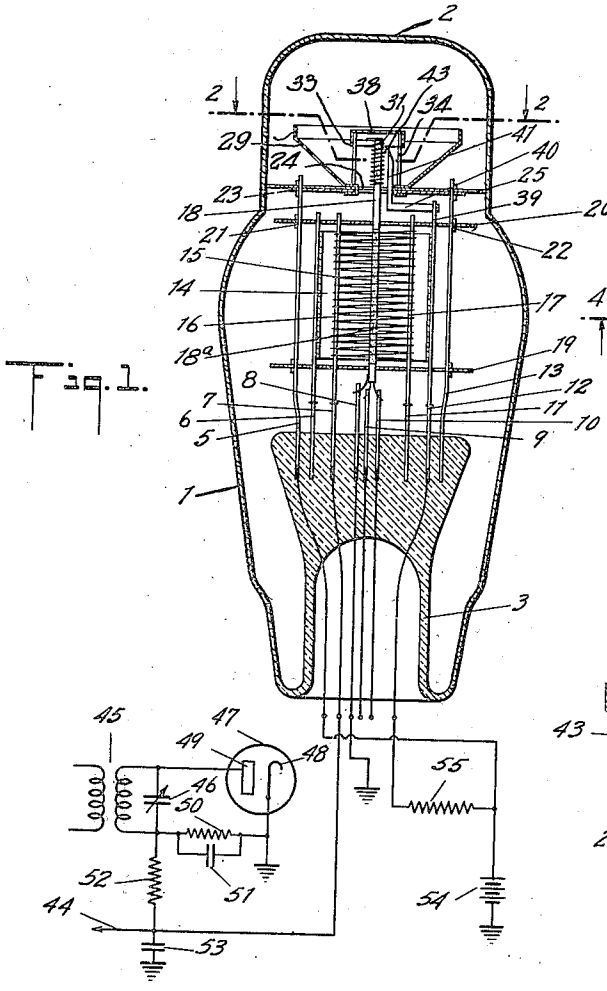


Fig. 1.

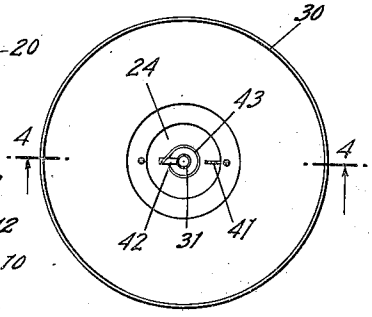


Fig. 3.

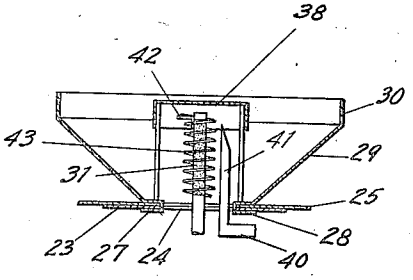


Fig. 4.

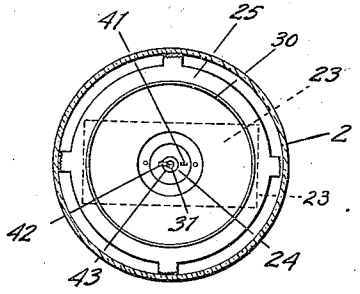


Fig. 2.

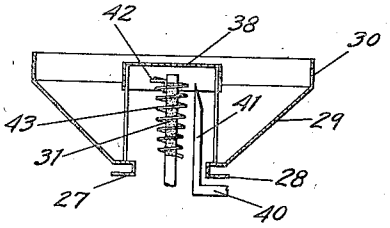


Fig. 5.

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FLUORESCENT INDICATING DEVICE

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Application June 3, 1937, Serial No. 146,137

5 Claims. (Cl. 250—27.5)

This invention relates to electron discharge tubes and more particularly to devices for indicating the condition of tuning of a part or parts of a wave signaling system and the like, such for example as a radio set.

The invention is in the nature of an improvement on the type of tuning indicator device disclosed in application Serial No. 99,755, filed September 8, 1936, and U. S. Patent No. 2,223,285.

There are disclosed in said applications tuning indicator devices of the glowing or fluorescent target type, including a target electrode coated with fluorescent material, an electron emitter, and an electron ray control electrode. The present invention has for its principal object to provide such types of tuning devices with an additional or auxiliary electrode whereby the fluorescence of the target is smoother and more uniform. As a result the emitter can be subjected to the normal processing without danger of the variation in electron emission resulting in non-uniformity of fluorescence, and without danger of the device arcing or blowing out when on the usual life test schedule.

A feature of the invention relates to a tube with a fluorescent target, an electron emitter and control electrode, together with a special grid or auxiliary electrode for controlling the space charge between the emitter and target.

Another feature relates to a tube having a support coated with fluorescent material, in conjunction with means to vary the fluorescent area, and an auxiliary electrode or grid for controlling the space charge without introducing appreciable electron shadows on the fluorescent area.

A further feature relates to a tuning indicator tube of the fluorescent target type, having a grid electrode which is free from vertical supports such as the usual grid side rods or the like, as a result of which the fluorescent area is substantially free from discernible electron shadows and is more smooth and uniform.

A further feature relates to the novel manner of supporting a grid electrode from a cathode or similar electrode.

A still further feature relates to the novel organization, arrangement and relative location of parts which constitute an improved tuning indicator tube for radio sets and similar apparatus.

Other features and advantages not specifically enumerated will be apparent after a consideration of the following detailed descriptions and the appended claims.

While the invention will be described herein as embodied in a device useful for tuning indicator purposes, it will be understood that in certain of its aspects the invention is capable of application in other devices. Accordingly in the drawing,

Fig. 1 is a vertical elevational view, partly in section, of a tube embodying features of the invention. This figure also schematically shows the tube connected in a typical circuit.

Fig. 2 is a sectional view of Fig. 1 taken along the line 2—2 thereof.

Fig. 3 is an enlarged top plan view of part of Fig. 1.

Fig. 4 is a sectional view of Fig. 3 taken along the line 4—4 thereof.

Fig. 5 represents a modification of the invention.

Referring to Fig. 1, there is shown a tube or enclosing envelope 1 having at least its upper end or dome 2 of glass, it being understood that, if desired, the remainder of the tube envelope may be of metal as is well-known in the radio tube art. Sealed into the tube 1 is a base or stem 3 into and through which are sealed the various lead-in and support wires 5 to 13 inclusive. It will be understood of course that while the drawing shows a tube employing a triode mount of the indirectly heated type, any other well-known type of radio tube mount may be employed. Supported on the wires 6 and 12 is the tubular plate or anode 14 which surrounds a fine wire grid 15, the latter being supported by means of its side rods 16, 17 on the wires 7, 11. Supported centrally of the grid and plate is a cylindrical or other well-known form of indirectly heated cathode comprising a tubular metal sleeve 18 on the interior of which is positioned an insulated heater wire having its ends connected to wires 9, 10. The metal cathode sleeve 18 is connected to the lead-in wire 8 and is provided with the usual electron emissive coating as indicated by the stippled area 18a. In accordance with the usual practice a pair of insulator members or spacers 19, 20 in the form of mica or ceramic discs are provided to maintain the spacing of the various electrodes. These discs are provided with perforations through which pass the various side rods for the electrodes as well as the supports 5 and 13, and the discs are held in place on the latter supports by eyelets or tabs 21, 22 or the like.

The supports 5 and 13 extend upwardly beyond the disc 20 and carry a metal strip or disc 23 having an enlarged central opening 24 through which passes centrally thereof the cathode sleeve 18. Preferably, a mica disc 25 is also attached to the supports 5 and 13, said disc having radial extensions

or teeth to engage the wall of the dome 2 so as to steady the mount, it being understood that the disc 25 has an opening similar to the opening 24. Supported on the discs 23 and 25, for example by the depending lugs 27, 28 is a cup-shaped metal member 29 having its bottom wall provided with an opening corresponding to the opening 24 and the corresponding opening in disc 25. Member 29 is therefore electrically connected through member 23 to wire 5. Preferably, although not necessarily, the member 29 is provided with a circumferential flange 30 and the entire inner face of member 29 is coated with a suitable material or materials which fluoresce when bombarded with electrons from the cathode. These bombarding electrons are emitted from the electron emissive coating 31 which is provided near the upper end of the cathode sleeve 18.

The cathode when at emitting temperature is luminous, and in order to blank off this light from interfering with the fluorescence, there is provided a blackened shield 38 in the form of a circular metal cap which may be supported on the wires 33, 34 welded or otherwise fastened to the bottom of the member 29. In order to control the shape of the electron rays or streams from the cathode so as to control the extent of the fluorescent area on the target, there is attached to the plate side rod 39 an L-shaped member 40 having the upper end of the vertical arm 41 preferably, although not necessarily, pointed. Arm 41 extends upwardly through the openings in members 23 and 25 as shown in detail in Fig. 4 and is preferably co-extensive with the coating 31. Preferably the arm 41 is in the form of a flat strip mounted parallel to, and in the same plane as the vertical axis of the cathode sleeve.

Attached, as for example by welding, to the upper end of the cathode sleeve is a right-angled tab 42, and surrounding the upper portion of the sleeve, preferably coextensive with the coating 31, is a helically coiled grid 43. In accordance with the invention the grid 43 is free from any vertical supports, such as the usual grid side rods or the like, and the grid wire is preferably of a refractory wire of high tensile strength, such for example as tungsten. It will be understood that the grid wire is of sufficiently heavy gauge that it is capable of being coiled and set to the required helical shape and the turns are self-supporting to the extent that they do not change their relative spacings and distance from the cathode, even when the assembly is subjected to mechanical jars. It will be understood that, if desired, the grid may be fastened at its lower end to the cathode instead of at its upper end, or it may be fastened at both ends to the cathode.

I have found that with the type of grid disclosed, it is possible to secure greater uniformity and smoothness in the fluorescent glow on the target 29. Probably one of the reasons for this is that the grid being free from any vertical supports and being relatively close to the cathode, the electron shadow of such supports on the target is avoided. This is due to the geometry of the arrangement since any vertical member relatively close to the cathode and being at cathode potential casts a relatively large electron shadow on the fluorescent target, whereas horizontal or approximately horizontal elements are under-focussed by the electron stream, and cause only a slight shadow. I have found that over a wide range of grid pitches, for example from 30 to 40 t. p. i. with 4 or 5 mil tungsten or molybdenum grid wire, that the horizontal shadow or pattern of the grid wires on the fluorescent target is very slight and hardly discernible at all.

The grid in addition to smoothing out the fluorescent area, also has the advantage that being at cathode potential it acts to limit the current between cathode and target, by negative space charge action. As a result when the device is being tested, for example on the usual life test schedule, there is little chance of the target current becoming excessive or of forming destructive arcs or blowouts within the tube. Furthermore, the grid to a certain extent overcomes the tendency of unequal or non-uniform emission from the cathode to produce corresponding variations or non-uniformity in the fluorescent glow.

It will be understood that while a grid of a certain number of turns and pitch has been disclosed, that a greater or less number of turns may be used and if desired the turns instead of being of uniform circular diameter, may be of increasing diameter or slope, as illustrated schematically in Fig. 5, to correspond with the slope of the target 29.

While any well-known circuit arrangement may be utilized for impressing the proper voltages on the electrodes 29 and 41, a typical arrangement is illustrated in connection with Fig. 1. In this circuit, the triode unit comprising the cathode 18*a*, control grid 15 and plate 14 acts as a D. C. amplifier of a suitable D. C. voltage proportionate to the accuracy of tuning. Thus this voltage may be developed by an automatic volume control device or by a suitable detector. The conductor designated 44 in Fig. 1 represents schematically a connection to a suitable source of A. V. C. potential. The numeral 45 represents a radio frequency or intermediate frequency coupling transformer which is energized under control of the waves to be tuned-in. The secondary of this transformer may be provided with a tuning condenser 46 or the like. The currents in the secondary of the transformer are rectified in any well-known manner for example by the electron tube rectifier or diode 47 having an electron emitting cathode 48 and an anode 49 having a suitable load resistor 50 and parallel condenser 51. The rectified voltage across resistor 50 is impressed through resistor 52 on the control grid 15, and preferably a by-pass condenser 53 is connected between grid 15 and cathode 18. The source of steady potential 54 is connected in series with the triode load resistor 55 between the plate 14 and cathode 18*a*. The plate current of the triode flowing through resistor 55 correspondingly varies the potential difference between the target 29 and control electrode 41 which is directly connected to plate 14. Since the plate current of the triode will vary in accordance with the voltage developed across the tuned circuit 45, 46 and therefore in accordance with the accuracy of tuning of the system to a received carrier wave, the luminous condition of target 29 will give a visual indication of the tuning. Likewise since the potential of the control electrode 41 is a function of the A. V. C. voltage it is possible to control the sensitivity of the tuning indicator in accordance with the field strength of the signal being received as described in detail in application Serial No. 99,755, filed September 8, 1936.

The control electrode 41 instead of being of the shape shown in the drawing, may be in the form of a wire loop surrounding the cathode as disclosed in said U. S. Patent No. 2,223,285.

While certain specific embodiments and circuit connections have been disclosed herein, it will be understood that various changes and modifications may be made without departing from the spirit and scope of the invention.

What I claim is:

1. A tuning indicator device for radio sets and the like comprising an electron emitter, a fluorescent target for said emitter, and a unipotential grid surrounding said emitter, said grid consisting of a coiled wire supported on and connected to said cathode and being free from supports extending longitudinally of the emitter whereby the fluorescence of the target is rendered uniform.

2. A tuning indicator device for radio sets and the like comprising a central unipotential electron emitter, an annular fluorescent target surrounding said emitter, a control electrode for controlling the fluorescent area of the target, and a helical grid with self-supporting turns free from side rods or the like which tend to cause electron shadows on said target interposed between the emitter and the target, said grid being connected direct to the cathode.

3. An electron indicator device comprising an electron emitter, a fluorescent target surrounding said emitter, and a plural turn grid between said emitter and target, said grid being free from the usual grid side-rod supports which tend to cause electron shadows on said target and being electrically connected to the emitter to limit the current between the emitter and target.

4. An electron indicator device comprising an electron emitter, a fluorescent target surrounding said emitter, and a plural turn grid between said emitter and target, said grid having successive turns of different diameter, said grid being adapted to be maintained at a potential not greater than that of the emitter.

5. A tuning indicator device for radio sets and the like comprising a cylindrical electron emitter, a coiled grid surrounding said emitter and adapted to be maintained at substantially the same steady potential as the emitter said grid being free from the usual grid support side-rods which tend to cause electron shadows, a strip-like fluorescence control electrode mounted in edge-on relation to said cathode, and a cup-shaped fluorescent target surrounding said electrodes.

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