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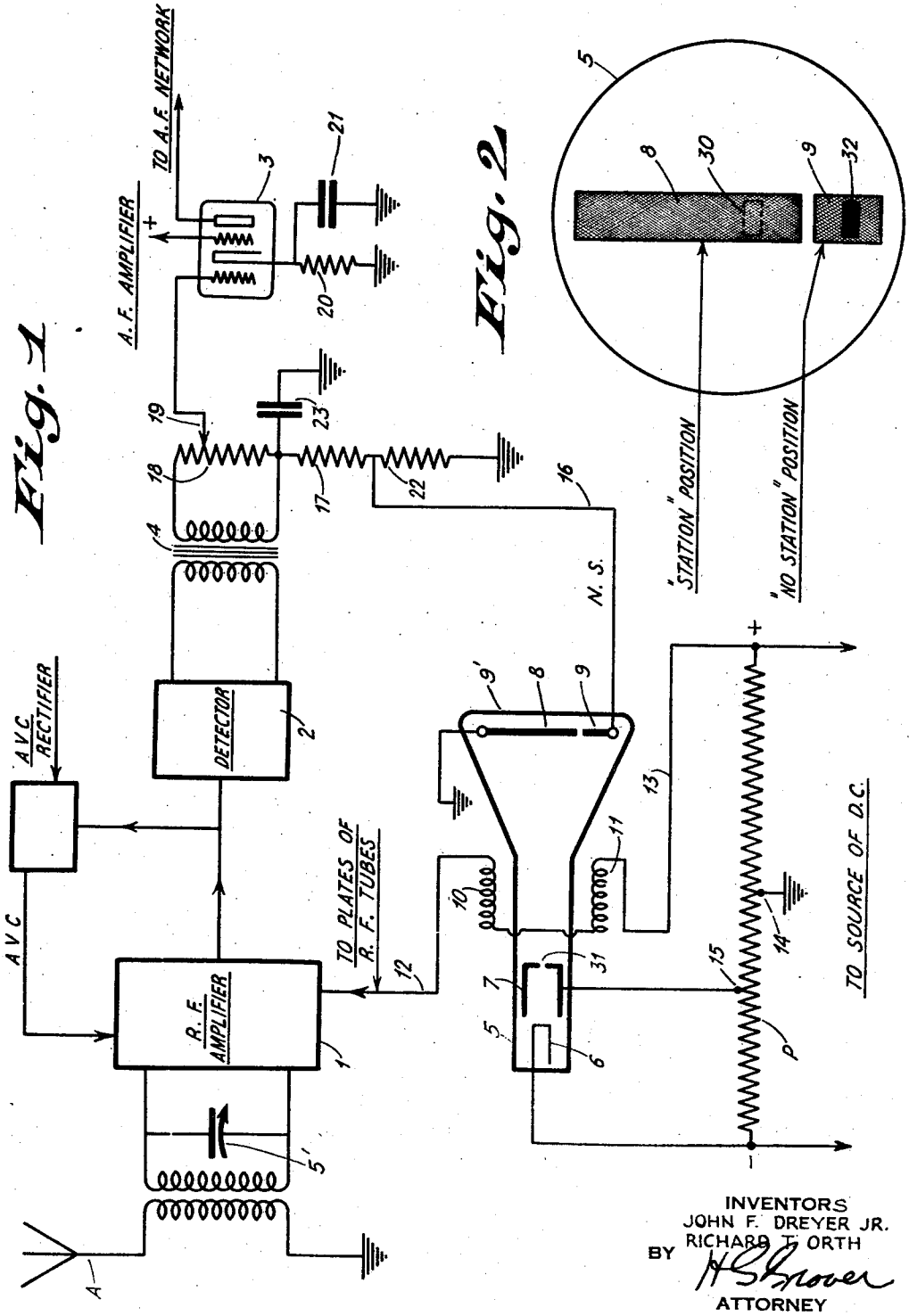


Fig. 1

Fig. 2

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CATHODE RAY TUBE NOISE GATE SYSTEM

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6 Claims. (Cl. 250—20)

Our present invention relates to amplification control systems, and more particularly to a novel and improved system for automatically regulating the gain of the audio and radio amplifiers of a signal receiving system and simultaneously indicating the resonance condition of the system.

Signal receiving systems are customarily equipped at the present time with automatic volume control circuits. It is, also, usual to provide such receiving systems with resonance indicators so that the tuning of the system is rendered comparatively simple. Furthermore, and in order to avoid or minimize interchannel background noises, radio receivers equipped with automatic volume control circuits have been provided with muting, or squelching, networks. From the viewpoint of economy in set production, it is obvious that the resonance indicator, as well as the muting network, should involve as few circuit elements as possible. Additionally, the muter circuit, regardless of its point of application in the transmission system, should be highly efficient and positive in muting action.

Accordingly, it may be stated that it is one of the main objects of our present invention to provide a unitary electrical instrumentality in a radio receiver equipped with automatic volume control, which instrumentality is of the cathode ray type, and not only functions to visually indicate the resonance condition of the receiver while the receiver is being tuned, but simultaneously functions as a noise gate, or muting device, in order to suppress background noises which are usually amplified when the received signal intensity falls below a predetermined minimum value.

Another important object of the present invention is to provide a cathode ray tube in a radio receiver equipped with automatic volume control, and which cathode ray tube performs a double function in the receiver; one of these functions resulting in a visual indication of the resonance status of the receiver, while the other function results in an impairment of the transmission efficiency of the receiver when the received signal intensity decreases below a predetermined magnitude.

Another object of our present invention is to provide a novel type of cathode ray tube for a radio receiver, the tube being capable of functioning as a combined noise gate and tuning indicator, and the tuning indication being provided on an electrode of the cathode ray tube which is provided with a coating of electron-responsive material.

Still other objects of the present invention are to improve generally the simplicity and efficiency of noise gate and tuning indicator devices for radio receivers equipped with automatic volume control, and to particularly provide such devices which are not only efficient in operation, but economical to manufacture and assemble in a radio receiver.

The novel features which we believe to be characteristic of our 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 we have indicated diagrammatically a circuit organization whereby our invention may be carried into effect.

In the drawing:

Fig. 1 shows a radio receiving system embodying the present invention,

Fig. 2 shows a cathode ray tube embodying the present invention when viewed from the indicator side of the tube.

Referring now to the accompanying drawing, there is shown in Fig. 1 a radio receiving system of a conventional type. Since the combined noise gate and tuning indicator of the present invention is independent of the type of radio receiver utilized, as well as independent of the nature of the automatic volume control network, the various circuits of the receiving system up to the audio frequency amplifier have been conventionally designated. For example, the reference characteristic A denotes the usual signal collector, such as a grounded antenna circuit. The signal collector is coupled to a radio frequency amplifier 1, and the output of the radio frequency amplifier is impressed upon a detector 2. The detected output of the detector 2 is impressed upon an audio frequency amplifier 3 through a coupling transformer 4, and the audio output of tube 3 may be further utilized in additional audio amplifiers, or in a reproducer.

These elements are, in general, the usual networks embodied in a radio receiving system. The reference numeral 5' denotes the customary symbol employed for representing the tuning means of the radio receiver. It will be understood that the radio frequency amplifier 1 may embody a plurality of stages of tuned radio frequency amplifiers, or, as in the case of the superheterodyne receiver, the numeral 1 will designate the usual radio frequency amplifier, local oscillator, first detector and intermediate frequency ampli-

fier networks feeding the audio demodulator, or second detector.

In any case, the numeral 2 denotes the audio demodulator of the receiving system, and the numeral 5 designates the tuning means of the receiver, which tuning means may be adjusted throughout the tuning range of the receiver; the tuning range may be, for example, in the broadcast range.

The automatic volume control mechanism of the receiver, being independent of the combined noise gate and tuning indicator, has been conventionally represented. The automatic volume control may be provided by feeding a portion of the signal input to the audio demodulator 2 to a rectifier which functions to convert the signal currents to a rectified current, and the rectified current will then be used to vary the grid bias of the radio amplifier tubes. Since such systems are very well known to those skilled in the art at the present time, it is believed merely necessary to denote the network in conventional form and make general reference to such systems known in the prior art so that those skilled in the art may readily construct the present invention. An automatic volume control system which may be used in connection with the present invention is disclosed by Chittick and Carlson in application Serial No. 642,544, filed November 14th, 1932.

A radio receiver of present day construction is highly sensitive and selective, and side band cutting will result unless the receiver is tuned to precise resonance with the desired carrier frequency. In the case of a radio receiver equipped with automatic volume control, this disadvantage is marked, and becomes even more aggravated by the fact that "ear" tuning is practically impossible. For this reason visual tuning indicators have been proposed for use in connection with radio receivers provided with automatic volume control.

Again, whenever the tuning means 5 of a receiver provided with automatic volume control is adjusted to a point such that no signals are received, the automatic volume control network is not operating, and this increases the amplification of background noises. For this reason noise gate networks, or muter circuits, have been utilized to quiet the receiver while the receiver is being adjusted from one signal channel to a following signal channel. The muting action may be applied to any point in the transmission network. According to the present invention, the functions of muting and tuning indication are performed by a single instrumentality.

This instrumentality comprises a cathode ray tube, generally denoted by the reference numeral 5, and it will be recognized that the cathode ray tube has been conventionally represented. The cathode ray tube 5 is substantially similar in construction to tubes of this type well known to those skilled in the art, and differs from such well known tubes in the details to be hereinafter described. The tube 5 generally has the shape shown and is provided with the usual cathode 6, the cathode being of the indirectly heated type, focussing cylinder 7 and electrodes 8 and 9. The electrode 9 is disposed in the same plane as the electrode 8, but the electrode 8 is of a substantially greater length than the electrode 9. Both electrodes have the same width, and, as shown in Fig. 2, they are both made of a mesh material and coated with willemite.

The willemite material is well known to those skilled in the art, and is commonly employed for coating the inner face of the viewing face 9' of the cathode ray tube 5. For reasons to be given at a later point the willemite is not applied to the inner face of viewing disc 9', but is applied instead to the electrodes 8 and 9, and the composition is preferably sprayed over the exposed faces of the electrodes 8 and 9. Of course, the willemite material may be applied to the mesh electrodes 8 and 9 in any other fashion, and it is to be clearly understood that any other type of fluorescent material may be applied to the electrodes 8 and 9.

The electron beam emitted from cathode 6, and focussed by cylinder 7, is displaced along the length of electrodes 8 and 9 by the varying magnetic field provided by coils 10 and 11. These two coils, providing magnetic deflection of the electron beam, or stream of cathode rays, are simply connected in series in the plate supply of the controlled radio frequency amplifier tubes. They are conventionally represented, but are to be understood as having their axes in alignment, and their common axis at right angles to the axis through electrodes 8 and 9.

Accordingly, the lead 12 has been shown connected to the plates of the radio frequency tubes, and the plate supply lead 13 is shown connected to the positive terminal of the energizing direct current source generally denoted by the reference letter P. It will be understood, of course, that the resistor, or potentiometer, P is the usual bleeder resistor connected across the power supply network, which network may include the usual alternating current rectifier and filter system. An intermediate point of the bleeder P may be grounded, as at 14, and the focussing cylinder may be connected to a point 15 on bleeder P which is intermediate the negative side of the bleeder and the ground point. The electrode 8 is grounded, while the electrode 9 is connected by lead 16 to the signal grid of audio amplifier 3 through a path which includes a filter resistor 17, the manual volume control resistor 18, and the adjustable tap 19.

The resistor 18 is connected across the secondary of coupling transformer 4, and the cathode of the audio amplifier 3 includes the usual grid bias resistor 20, by-passed by condenser 21, the grid bias resistor being connected to ground so as to provide a return path to the energizing network. It will also be noted that the lead 16 is connected to a point intermediate resistor 17 and a secondary resistor 22 which functions as the cathode ray tube auxiliary plate resistor. One side of resistor 22 is grounded, and a by-pass condenser 23 is connected between the low alternating potential side of resistor 18 and ground.

In Fig. 2 is shown the appearance of the viewing end of the cathode ray tube 5 both in the case when a station has been tuned in, and when there is no station being received. The dotted lined rectangle 30 designates the appearance of the image of the rectangular slit 31 of focussing cylinder 7, which image appears upon the electrode 8 when a station has been tuned in. The image 30 is, of course, caused by the electron beam which passes through the slit 31 and impinges upon the inner face of electrode 8. The electrons, striking the willemite coating of the electrode 8, cause a fluorescence, or glow, and thus a glowing rectangular area appears on the electrode 8. The dark rectangular area 32 appearing on electrode 9, in Fig. 2, shows the position of the area 32 when no station is being received. It will be observed that the electron beam has been deflected from elec-

trode 8 to electrode 9. In other words as the resonance condition of the receiver varies, the rectangular image of electrodes 8 and 9 varies in its position, and this is due to the magnetic deflection caused by coils 10 and 11.

Since the flow of current through the path including coils 10 and 11 is a minimum when the tuning means 5 has been adjusted to exact resonance with a desired carrier, it necessarily follows that the magnetic deflection of the electron beam will be a minimum, and, therefore, at exact resonance the rectangle 30 will be adjacent the top of electrode 8. As the set is tuned away from resonance the plate current flow through coils 10 and 11 will increase, and the electron beam will slowly move down the electrode 8 until it appears on the electrode 9. In this way, the user of the set can readily tell not only whether or not the set is in tune to a desired station, but can also tell whether or not the set is in exact resonance with the desired carrier. Of course by varying the configuration of slit 31, or disposing a plate between focussing cylinder 7 and electrodes 8 and 9, which plate has a beam aperture of any desired design, the image on the electrodes 8 and 9 can be made to have any desired configuration. For example, the image can take the form of a trade-mark, or any fanciful figure. Such a plate could be placed between the cylinder 7 and coils 10, 11. This plate would, also, be connected to bleeder P at a point between points 14 and 15.

The beam current in the cathode ray indicator is considerably high, and can be of the order of 100 micro-amperes. Since this is the case, the beam current can be utilized to secure the noise gate function. The electrode 9 receives the electron stream when signals are not tuned in, or are not sufficiently strong to deflect the beam upon electrode 8. Since the electrode 9 is connected by a direct current path to the grid circuit of audio amplifier 3, it will be seen that when the beam strikes the electrode 9 a direct current voltage is produced.

When applied to the grid of audio tube 3, this voltage is of sufficient magnitude to bias the audio tube substantially to cut-off. Thus, the transmission through tube 3 to the reproducer is rendered highly inefficient, and the receiver has been silenced. It will, of course, be understood that when the electron beam is focussed upon electrode 8, there is provided on the grid of audio amplifier 3 the normal operating negative bias produced across biasing resistor 20. As soon as the electron beam strikes electrode 9, however, an additional negative bias is applied upon the grid of the audio tube, and produces the silencing action.

Obviously the direct current path between electrode 9 and the signal transmission network may be applied to any other point in the receiving system, the essential requirement being to produce an auxiliary negative biasing action upon an electrode, which auxiliary biasing action results in inefficient transmission through the receiving network. An important advantage in coating electrodes 8 and 9 with the willemite material, and not disposing it upon the inner face of viewing disc 9' as is usually done, resides in the fact that no secondary electrode emission is encountered. If the willemite material were disposed upon the inner face of disc 9' as is customarily done, sufficient secondary emission would be encountered when the set was in tuned condition to perform silencing of the audio amplifier. By providing the electrodes 8 and 9 with the willemite material these electrodes not only perform the visual tuning indication function, but, additionally, provide muting action in an efficient and positive manner.

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

What is claimed is:

1. In combination with a radio receiver provided with an automatic volume control network, a combined noise gate and tuning indicator characterized by the fact that the indicator comprises a cathode ray tube including a pair of electrodes provided with fluorescent material, one of said electrodes being connected to a point of fixed potential, and the other electrode being connected to said point through an impedance, means for producing an electron beam within the tube, means for magnetically deflecting the electron beam within the cathode ray tube in accordance with variations in received signal intensity, and a direct current connection between a gain control electrode of a transmission tube of said receiver and the electrode side of said impedance.

2. In a system as defined in claim 1, said magnetic deflection means comprising a pair of coils arranged in the plate current supply lead of the radio frequency amplifier of the receiver.

3. In a system as defined in claim 1, said pair of electrodes being disposed in a common plane, and said fluorescent material being such that a luminous indication appears on the electrodes whenever the electron beam impinges thereupon.

4. In a radio receiver including a radio frequency amplifier, an audio demodulator and an audio frequency amplifier, automatic volume control means for maintaining the signal input intensity to the audio demodulator substantially constant regardless of signal input variations in the radio frequency amplifier input, a cathode ray tube provided with means for producing an electron beam and a pair of electrodes, means electrically connected with the plate current supply of the radio frequency amplifier for magnetically deflecting the electron beam in response to variations in received signal intensity, said pair of electrodes being provided with a coating of fluorescent material, one of said electrodes being connected to a point of fixed potential, and the other electrode being connected to said point through an impedance, and a direct current connection between a gain control electrode of said audio amplifier and the electrode side of said impedance whereby said audio amplifier is rendered highly inefficient with respect to electrical transmission when the electron beam falls upon said other electrode.

5. In a signal reception system of the type provided with a signal transmission tube network, a demodulator network and an audio amplifier tube network, means for automatically regulating the transmission efficiency of said transmission network in response to variations in received signal amplitude in a sense to maintain the signal amplitude at the demodulator input substantially constant, a cathode ray tube provided with at least means for producing an electron beam and a pair of electrodes, one of said electrodes being connected to a point of relatively fixed potential, and the other electrode being con-

nected to said point through an impedance, means, responsive to variations in the space current flow of said signal transmission network, for deflecting the electron beam upon said one electrode when signals of a desired amplitude are received and upon said other electrode when the amplitude of said signals falls below a predetermined intensity level, and means operatively associated with at least one of said networks and the electrode side of said impedance whereby said one network is rendered inefficient with respect to signal transmission when the electron beam falls upon said other electrode.

6. In a signal reception system of the type provided with a signal transmission tube network, a demodulator network and an audio amplifier tube network, means for automatically regulating the transmission efficiency of said transmission network in response to variations in received signal amplitude in a sense to maintain the signal amplitude at the demodulator input substantially constant, a cathode ray tube provided with at least means for producing an electron beam and a pair of electrodes, one of said electrodes being connected to a point of relatively fixed potential, and the other electrode being connected to said point through an impedance, means, responsive to variations in the space current flow of said signal transmission network, for deflecting the electron beam upon said one electrode when signals of a desired amplitude are received and upon said other electrode when the amplitude of said signals falls below a predetermined intensity level, and means operatively associated with at least one of said networks and the electrode side of said impedance whereby said one network is rendered inefficient with respect to signal transmission when the electron beam falls upon said other electrode, and said pair of electrodes being provided with a coating of fluorescent material whereby a luminous indication appears on the electrodes whenever the electron beam impinges thereupon.

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