June 23, 1936. W. R. KOCH 2,045,542

COMBINED NOISE SUPPRESSER AND TUNING INDICATOR

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Fig. 1

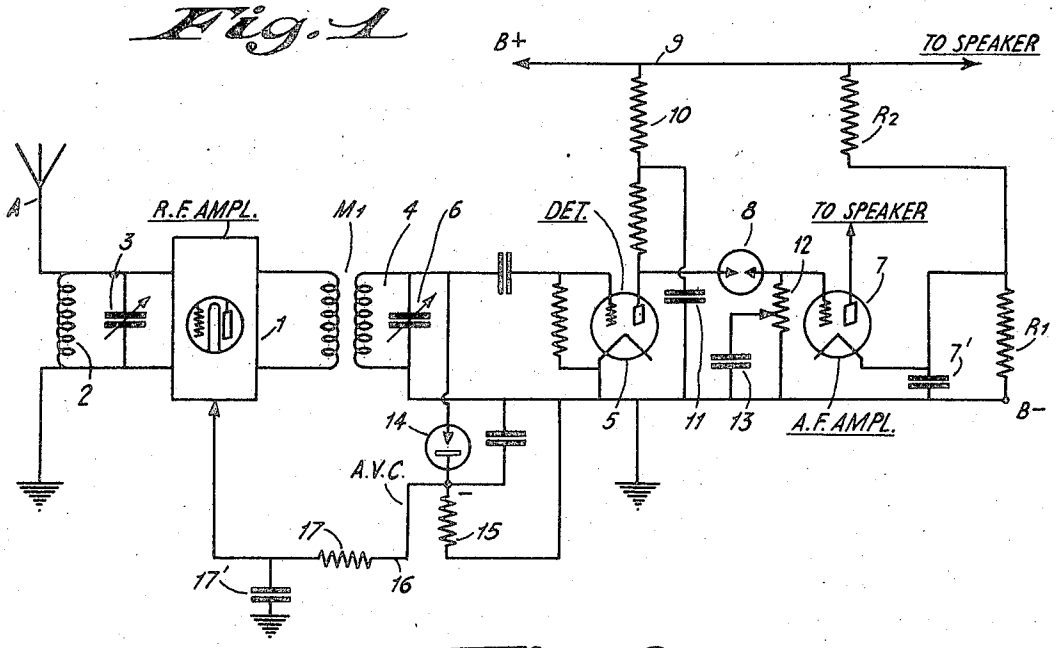


Fig. 2

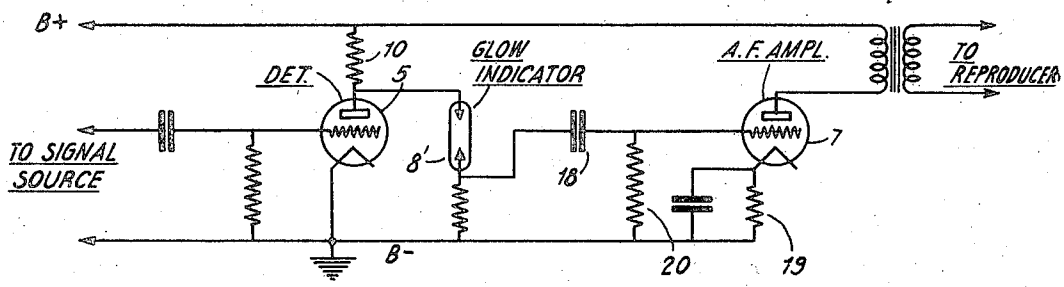
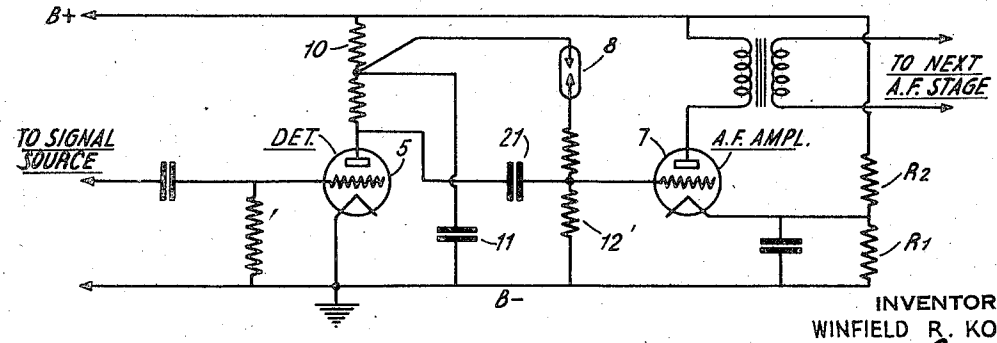


Fig. 3



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COMBINED NOISE SUPPRESSER AND TUNING INDICATOR

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10 Claims. (Cl. 250—20)

My present invention relates to radio receiver control circuits, and more particularly to a combined back-ground noise suppresser and tuning indicator for a radio receiver.

There are certain types of radio receiving systems wherein it is desired to have the receiver rendered inoperative to reproduce electrical impulses impressed thereon until a predetermined signal intensity level has been attained. For example, radio receivers including automatic volume control, or receivers of the automatically tuned type, are illustrations of such types of receivers. In the case of the former when the received signal intensity falls below a predetermined intensity level, the action of the automatic volume control is in a direction such that background noise impulses are greatly amplified.

In the case of receivers utilizing automatic tuning, the automatic tuning mechanism tends to produce undesired electrical impulses which are reproduced when the system is tuned from one predetermined station position to another one. It is highly desirable to silence, or quiet, the receiving system between such predetermined tuning points. There may be other situations where it is desired to render the receiving system inefficient whenever the useful signal energy decreases below a predetermined point.

Accordingly, it may be stated that it is one of the main objects of my present invention to provide a combined background noise suppresser and tuning aid whereby the receiving system will be rendered silent except when a signal is tuned in, the suppresser also functioning as a tuning indicator when the desired signal energy exceeds a predetermined intensity level.

Another important object of the present invention is to provide in a signalling system a gaseous tuning indicator for indicating visually the resonance condition of the system, and to additionally maintain the system inefficient until a predetermined signal intensity level has been exceeded.

Another object of this invention is to provide a neon glow tube between the detector and the audio frequency network of a radio receiver, the glow tube not only functioning as an indicator to show when signal energy above a predetermined intensity level has been received, but additionally acting to maintain the transmission efficiency between the detector and network relatively low until said intensity level has been exceeded.

Still other objects of the present invention are to improve generally the simplicity and efficiency of background noise suppressers and tuning indicators for radio receivers, and to particularly provide a combined background noise suppresser and tuning aid for a radio receiver which is not only reliable in operation, but economically manufactured and assembled in a radio receiver.

The novel features which I believe to be characteristic of my 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 I have indicated diagrammatically several arrangements for carrying my invention into effect.

In the drawing,

Fig. 1 diagrammatically shows a receiver embodying one form of the present invention,

Figs. 2 and 3 respectively show two different modifications of the invention.

Referring now to the accompanying drawing wherein like reference characters in the different figures designate similar circuit elements, there is shown in Fig. 1 a receiving system of a well known type. For this reason the receiving system circuits are shown in purely conventional form, those skilled in the art being well aware of the details not specifically shown in the drawing. For example, the receiving system embodies the usual signal energy collecting means, such as a grounded antenna system A, the antenna being coupled to a network 1 through a tunable signal selector 2. It will be understood that the network 1 represents one or more stages of tuned radio frequency amplification arranged in cascade, and that the numeral 3 designates the tuning means for such stage, or stages.

The numeral 3 designates the symbolic representation of the variable tuning condenser means of the radio frequency amplifier network. The output of the network 1 is impressed, as at M_1, upon the tunable input circuit 4 of the detector stage, which stage includes electron discharge tube 5. The tuning circuit 4 includes a tuning condenser 6, and the control grid-cathode circuit of the detector tube 5 includes the usual leaky grid condenser construction for detecting by grid rectification.

An audio frequency amplifier stage succeeds the detector tube 5, the control grid of the audio amplifier tube 7 being connected to the anode of detector tube 5 through a path which includes the gaseous glow tube 8, the latter being of the neon gas type. Positive potential is supplied to the anodes of tubes 5 and 7 through a path

which includes the lead 9 connected to the positive side of the source B. This source is not shown, but it may be an alternating current source, whose output is properly rectified and filtered; or it may be a direct current source. The negative side of the source B is represented by the ground connection of the cathode leads of tubes 5 and 7.

The anode of tube 5 is connected to the positive potential supply lead 9 through a resistor 10, an intermediate point of said resistor being connected to ground through a by-pass condenser 11 in order to by-pass radio frequencies. One terminal of the neon glow tube 8 is connected to the anode side of plate circuit filter resistor 10, while the other terminal is connected to ground through resistor 12, a condenser 13 being connected between ground and an intermediate point of resistor 12. The anode of tube 7, and the lead 9, may be connected to another stage of audio frequency amplication, or, as shown in the drawing, to a loud speaker. The cathode of tube 7 is connected to ground through a resistor R_1, a second resistor R_2 being connected between the ungrounded side of resistor R_1 and the lead 9. A by-pass condenser 7' is connected between the cathode of the audio tube 7 and the —B lead of the system.

As far as the operation of the combined noise suppresser and tuning indicator is concerned, the networks preceding the detector tube 5 may be of any desired type. In other words, it makes little difference whether the network 1 embodies the usual superheterodyne receiver stages ahead of the second detector, or whether the network ahead of the detector tube 5 is a cascaded tuned radio frequency amplifier network. Where the receiver is of the superheterodyne type the condenser 6 is, of course, fixed, and resonates the circuit 4 to the operating intermediate frequency, the numeral 3 in that case designating the tuning means for the signal and local oscillator circuits feeding the intermediate frequency amplifier supplying the second detector tube 5. If the receiver is of the tuned radio frequency type, then the numeral 3 is to be understood as designating the tuning means for the cascaded tunable radio frequency amplifiers, and is to be considered as adapted for uni-control with the variable condenser 6.

The operation of the tube 8 and its associated circuits will now be considered in order to show how its operation adapts it for use with receivers of various types as discussed heretofore. Assuming that the tuning means of the receiver has been adjusted to a certain station, let it be further assumed that the tuning means is desired to be adjusted to a different station setting. As the receiver is tuned away from the old setting, the signal energy intensity level, considered with respect to circuit 4, decreases until there is practically no signal energy impressed across the input circuit 4 of the detector stage. With this condition of no signal input the detector plate voltage is a minimum, since the detector is of the leaky grid type.

Since the striking voltage of the neon glow tube 8 depends upon the detector plate voltage, it will be seen that with no signal input to the detector the neon tube is below its striking voltage, and it does not glow or transmit energy. The bias resistors are R_1 and R_2, and they function to keep the cathode of audio tube 7 at a substantial positive potential with respect to the —B side of the system. The grid is at —B potential, and the tube 7 is, accordingly, biased beyond cut-off until the neon tube 8 begins to function. When signals are received, that is when the tuning means of the receiver is adjusted to the new station setting, the detector plate voltage rises. The striking voltage of the tube 8 is exceeded, and the neon tube glows. The current through the neon tube reduces the negative bias on the control grid of tube 7 to a point such that the audio amplifier tube is rendered operative. Simultaneously the neon tube also transfers audio signal energy from the detector plate circuit to the control grid circuit of the audio tube.

It will now be seen that when a signal is tuned in and the detector plate voltage rises, the neon tube breaks down, and by its glow acts as an indicator to inform the operator that a station has been tuned in. It will also be observed that the tube 8 not only functions to render the audio tube 7 operative or inoperative, but, in addition, functions as a coupling device to transfer audio signal energy from the detector circuit to the audio network. The resistor 12 and condenser 13 are so chosen as to give the proper time delay constant to prevent bursts of static from operating the tube 8.

The combined suppresser and tuning indicator of the present invention is shown adapted to a receiving system utilizing an automatic volume control arrangement in Fig. 1. The automatic volume control arrangement is of a purely conventional type and embodies a diode rectifier having its cathode connected to the high potential side of circuit 4 and its anode connected through resistor 15 to the low potential side of the detector input circuit. The usual conductive connection 16, including the resistor-capacity filter 17, 17', is connected between the point of negative potential on resistor 15 and the grid circuits of network 1. Those skilled in the art are well aware of the specific circuit connections of an automatic volume control arrangement, and how the gain control lead from the control rectifier is to be connected to the grid circuits of the controlled amplifiers. The action of the automatic volume control arrangement may be improved by operating the diode rectifier from a broad circuit, leaving the detector working from a sharp circuit. The noise suppresser would then operate over a narrower band.

In a system employing automatic volume control the present invention is particularly useful, since, if the signal energy amplitude decreases below a predetermined intensity level, the tube 8 promptly renders the audio amplifier inoperative, and, additionally, ceases to transfer audio energy from the detector circuit to the audio network. The tube itself, due to its failure to glow, informs the operator that while the receiver is tuned to the proper station setting no signal energy is actually being impressed across the detector input circuit 4.

Similarly, in the case of a receiver including automatic tuning for the variable condensers 3 and 6, the device 8 and its associated circuits function to prevent audio reproduction between predetermined station settings. Of course, the glow tube 8 is preferably disposed in an opening in the control panel of the set so that the operator may observe the intensity of the tube glow as he tunes the receiver, the point of maximum glow informing the operator that the set is tuned exactly to the desired carrier frequency.

It may be desired to have the glow indicator

tube 8 only function as an audio coupling device and a resonance, or tuning, indicator. In Fig. 2 is shown a modification of the detector and audio amplifier circuits of Fig. 1 wherein the glow tube is shown as of an elongated type 8', one electrode of the tube 8' being connected to the detector anode side of resistor 10, while the other electrode of tube 8' is connected to ground, and through another path including condenser 18 to the control grid of the audio tube 7. The bias for the control grid of tube 7 is provided through the series resistors 19 and 20, and the bias on the audio tube 7 does not change at any time.

In the arrangement shown in Fig. 2 the detector tube 5 is again a grid leak detector, but in this case when a signal is tuned in the glow tube 8' begins to glow. It functions as an audio coupling path between the detector plate circuit and the input electrodes of the audio amplifier tube 7. In other words, in this modification the tube 8' does not function as a back-ground noise suppresser by virtue of audio bias cut-off control, but rather acts as a background noise suppresser because it functions as the audio coupling path. The tube 8', due to its elongated configuration, appears like a thermometer when disposed in the control panel of the receiver, the increasing glow informing the set operator of the resonance condition of the receiver.

In Fig. 3 is shown a modification of the arrangement shown in Fig. 2 wherein the audio signal coupling between the detector plate circuit and the audio amplifier 7 is accomplished through a coupling condenser 21, the tube 8 functioning, as in Fig. 1, as a control for the audio amplifier bias as well as a tuning indicator. The cut-off bias for the amplifier tube 7, in the absence of signal energy, is applied through resistors R_1 and R_2. When signal energy is received, and the striking voltage of tube 8 exceeded, the negative bias on the control grid of tube 7 is decreased, and the audio amplifier rendered operative.

It will now be appreciated that in Fig. 1 the tube 8 and its associated circuits combines with the resonance indication function, the two separate functions shown in Figs. 2 and 3, to wit: audio bias control and audio signal coupling between detector plate circuit and audio amplifier network. It is also to be clearly understood that the present invention is not limited to a gas discharge device 8 which is filled with neon gas, since any other gas filled tube could be employed in place of a neon tube, and such gas fillings are too well known to be enumerated. Again, the detector and audio tubes 5 and 7 in each figure may be of the well known duplex diode triode types. Also, the resistance-capacity coupling of Fig. 3 may be replaced by transformer coupling.

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

What I claim is:

1. A radio receiver of the type including a detector and a succeeding audio amplifier, characterized by the fact that a gas discharge device is connected between the detector plate circuit and the amplifier input circuit, and means connected in the amplifier input circuit for biasing the amplifier to cut-off in the absence of signals, said discharge device being of such construction that it is rendered conductive and glows when signals are impressed on the detector input, said device additionally being connected between the detector plate and amplifier grid for transferring detected signal energy to the audio amplifier when conductive, and said device being connected to the amplifier grid in opposition to said biasing means for removing said amplifier cut-off bias when the device becomes conductive.

2. In combination in a radio receiver, a source of radio frequency energy, a detector, an audio amplifier, a gas discharge tube connected between the detector output circuit and the amplifier input circuit, said discharge tube being in series between the detector plate and the amplifier grid and having a striking voltage characteristic such that it becomes conductive when radio frequency energy above a predetermined intensity level is impressed upon the detector, and the connection from the tube to the amplifier grid being such that the effective voltage difference between the amplifier grid and cathode is changed by the tube space current flow.

3. In a receiver, as defined in claim 2, said tube being a neon tube, and being the sole coupling element between the detector and amplifier whereby it is adapted to transfer detected signal energy to said audio amplifier when it is rendered conductive, said neon tube additionally indicating the resonance condition of the receiver.

4. In a radio receiver, as defined in claim 2, said audio amplifier including in its input circuit means for biasing the amplifier to cut-off in the absence of signals in the detector input circuit, said discharge tube connection to the amplifier grid being in opposition to said biasing means for reducing the cut-off bias when the tube becomes conductive by virtue of said series connection.

5. In a radio receiver of the type including a detector and a following audio amplifier, a neon glow tube connected between the detector plate circuit and the audio amplifier grid circuit and comprising the sole coupling element therebetween, and means for normally maintaining the control grid of the audio amplifier negatively biased to cut-off, said neon tube being connected to the amplifier grid in opposition to said bias means and having a characteristic such that it becomes conductive to decrease said cut-off bias, and operates to transfer detected signal energy to said audio amplifier when signals above a predetermined intensity level are impressed upon the detector.

6. In a radio receiver of the type including a detector and a following audio amplifier, a condenser connected between the detector plate circuit and the audio amplifier grid circuit, said condenser being adapted to transfer detected signal energy to the audio amplifier, and means common to the detector plate circuit and the audio amplifier input circuit, including a gas discharge tube, for biasing the audio amplifier to cut-off in the absence of signal energy and decreasing the cut-off bias in the presence of signal energy.

7. In a receiver of the type including a radio frequency amplifier, a detector and an audio frequency amplifier, means for regulating the gain

of the radio frequency amplifier in response to signal amplitude variations, means in the audio amplifier input circuit for biasing the audio amplifier to cut-off in the absence of signal energy in the detector input circuit, and a coupling path between the detector plate circuit and the audio amplifier input circuit, said coupling path including a common variable impedance device of the gas discharge type which has characteristics for decreasing said cut-off bias, indicating the resonance condition of the receiver, and transferring detected signal energy to the audio amplifier, when the received signal intensity level increases above a predetermined value.

8. In a signal transmission system, a pair of cascaded tubes, a source of signals coupled to the input electrodes of the first tube, a gas discharge tube including a pair of electrodes connected between the plate of the first tube and the grid of the second tube so that the gas discharge path is in series between the said plate and grid, the potential difference between the input electrodes of the second tube being changed by the space current of the gas tube when the latter is rendered conductive.

9. In a radio receiver including a detector, a neon glow tube in the detector plate circuit, said glow tube having a voltage characteristic such that it becomes conductive and glows when signal energy above a predetermined intensity level is impressed upon the detector input circuit, and an audio frequency amplifier having its control grid connected to the detector plate through the electrodes of said glow tube in a circuit arrangement such that the potential difference between the amplifier input electrodes is changed by the glow tube space current.

10. In a signal transmission system, a pair of cascaded tubes, a source of signals coupled to the input electrodes of the first tube, a gas discharge tube including a pair of electrodes connected between the plate of the first tube and the grid of the second tube so that the gas discharge path is in series between the said plate and grid, the potential difference between the input electrodes of the second tube being changed by the space current of the gas tube when the latter is rendered conductive, and means responsive to variations in signal amplitude at the source for automatically maintaining the signal amplitude at the input electrodes of the first tube substantially uniform.

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