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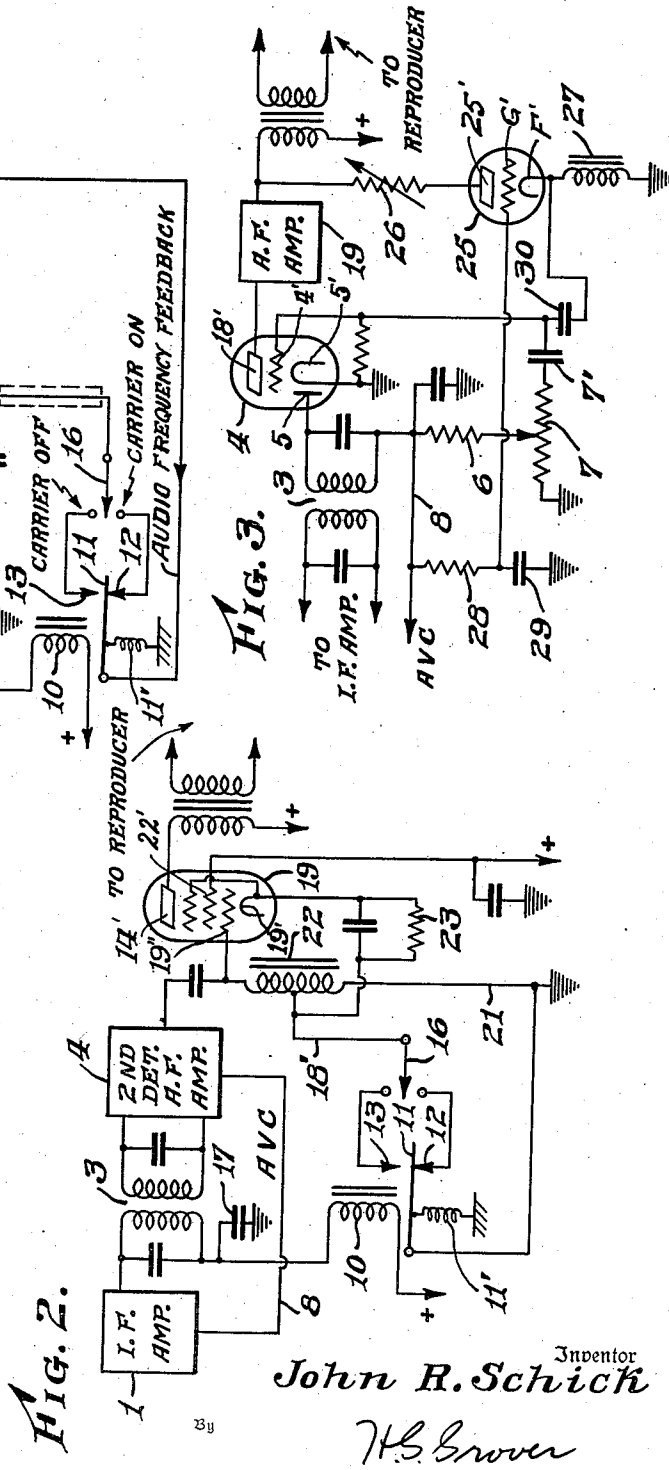
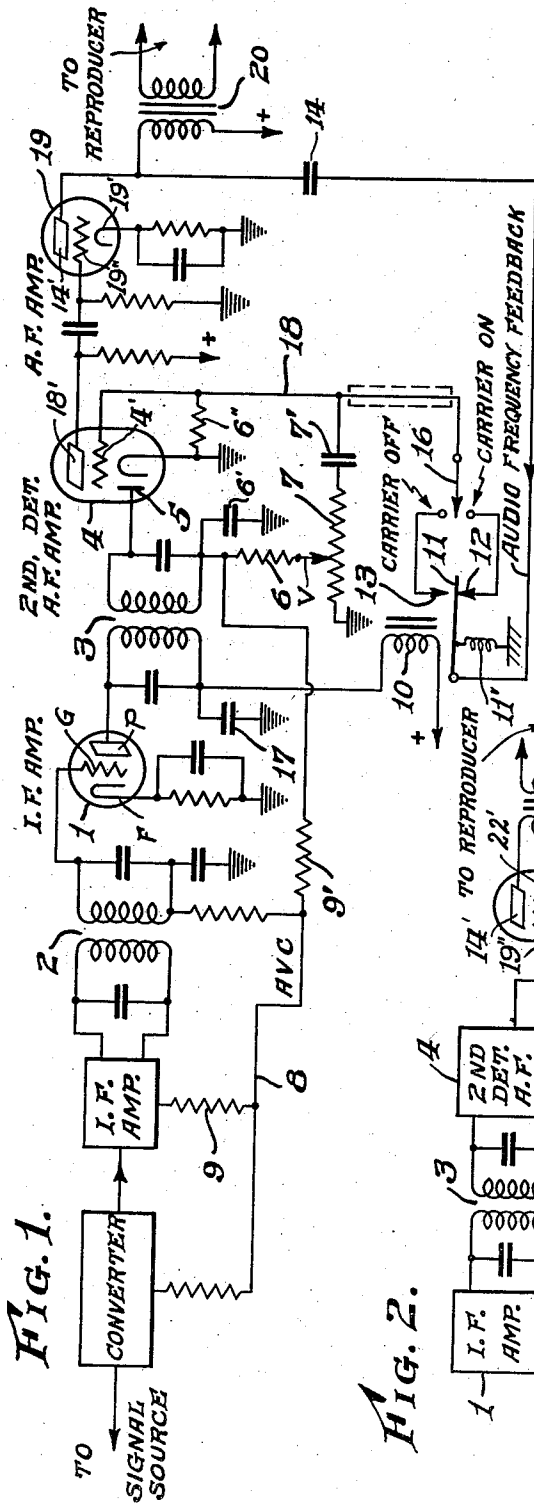
J. R. SCHICK

2,367,378

RADIO ALARM SYSTEM

Filed Aug. 26, 1942

2 Sheets-Sheet 1



Inventor
John R. Schick

W. B. Brown

Attorney

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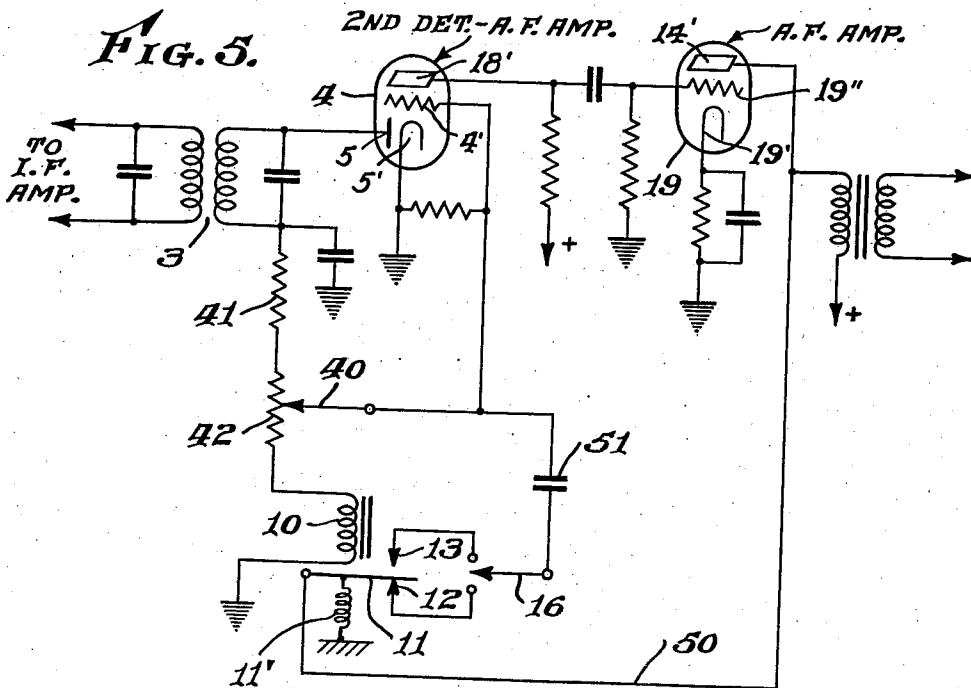
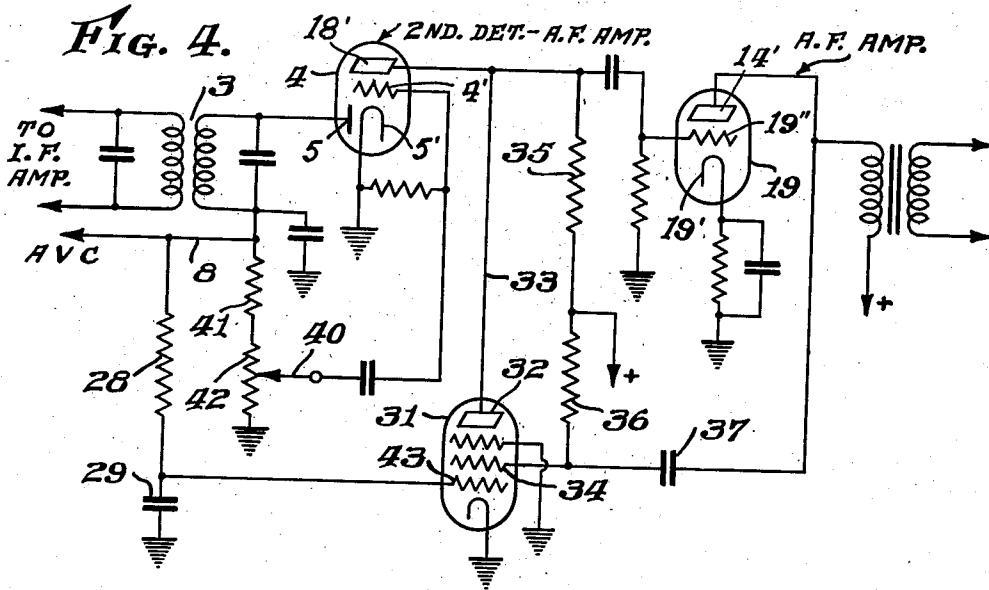
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Inventor
John R. Schick

39

H. E. Brower

Attorney

UNITED STATES PATENT OFFICE

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RADIO ALARM SYSTEM

John R. Schick, Santa Ana, Calif., assignor to
Radio Corporation of America, a corporation of
Delaware

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7 Claims. (Cl. 250—20)

My present invention relates to a radio black-out alarm system, and more particularly to a radio receiver employing an audible alarm circuit.

The usual arrangement employed for obtaining notice of a radio black-out, or shutdown, is to have a broadcast receiver running continuously on one of the key stations monitored for this purpose. In other words, each broadcast transmitter in a given area provides at its station a monitor broadcast receiver which constantly reproduces the program of the key station of that area. The disadvantages of this arrangement are that it is necessary to have the broadcast monitor receiver operating at an amplitude that causes constant distraction, and is detrimental to the operation of the business where the receiver is located. Again, it is sometimes desirable, or necessary, that the monitor engineer be listening to other equipment.

If the monitor operator is moving from room to room, the output amplitude of the receiver must be maintained very high, or it must be continually adjusted. It is evident that it is desirable to have a radio alarm system that will not make it necessary for the operator continually to monitor the modulation of the key station. It is desirable to have the attention of the operator called by an alarm when the key station carrier is either removed or applied. Again, it is desirable that whatever arrangement is used, it be simple, inexpensive and require no adjustments.

It may, therefore, be stated that it is one of the main objects of my present invention to provide a radio alarm arrangement which is applicable to a conventional radio broadcast receiver, and is able to provide an audible alarm which will indicate either the removal, or the application, of the carrier of the key station to which the monitor receiver is tuned.

Another important object of my invention is to provide a radio alarm system wherein a receiver is tuned to a key station, and there being included means for operating the receiver at any amplitude including sub-audible; a loud audible signal emanating from the receiver reproducer in response to the key station carrier being removed.

Another object of my invention is to provide a radio receiver which employs either a mechanical or vacuum tube relay, adapted to be actuated by a controlled amplifier stage, to introduce feedback into one or more audio frequency amplifier stages thereby to produce a loud audio frequency howl to simulate a siren effect.

Still another object of the invention is to pro-

vide an audio frequency feedback system in a radio receiver, and the feedback being effectively controlled from the receiver demodulator so that a loud alarm is heard from the reproducer in response to disappearance of a predetermined station carrier.

Still other objects of my invention are to improve the simplicity and efficiency of radio black-out alarm systems, and more especially to provide systems which are durable, reliable and economical to manufacture and assemble.

The novel features which I believe to be characteristic of my invention are set forth with 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 drawings, in which I have indicated diagrammatically several circuit organizations whereby my invention may be carried into effect.

In the drawings:

Fig. 1 shows a radio receiver embodying the invention.

Fig. 2 shows a modified form of audio frequency feedback circuit.

Fig. 3 illustrates an electronic form of feedback control relay.

Fig. 4 shows a modification in the mode of control of the relay, the control being from the demodulator.

Fig. 5 shows a modification of the arrangement of Fig. 4.

Referring now to the accompanying drawings, wherein like reference characters in the different figures denote similar circuit elements, the receiver of Fig. 1 is assumed to be a superheterodyne broadcast receiver which operates in the usual 550 to 1700 kilocycles (kc.) band. Those skilled in the radio art well know the manner of constructing such a receiver. It is to be understood, however, that my invention is independent of the receiver operating range, the type of receiver, or the nature of the carrier modulation. For example, the invention may be applied to a frequency modulated (FM) carrier wave receiver, as well as to an amplitude modulated carrier wave receiver.

In the schematic system of Fig. 1, the receiver may comprise the usual signal wave collector, such as a grounded antenna, which feeds the signals to one or more tuned radio frequency amplifiers. The selector circuits of the amplifiers, as well as the selective input circuit of the converter, will be kept tuned to the carrier frequency

of the key station of a given area. One transmitting station of a given broadcast area of stations is termed a "key" station. All other broadcasters as well as point to point stations, in that area will have receivers tuned to the key station carrier frequency. Of course, the homes of all persons in that area may, also, equip themselves with the present system so that they may concurrently be aware of the black-out signal. For example, air-raid wardens may use the system.

The converter, of any desired type, acts to reduce the carrier frequency to the intermediate frequency (I. F.). The I. F. energy is amplified to one or more amplifier stages. The last I. F. amplifier tube is designated as 1. Its input electrodes G and F are coupled to the secondary winding of an I. F. input transformer 2. The I. F. output transformer 3 couples the output electrodes P and F of tube 1 to the diode demodulator electrodes 5 and 5'.

The diode is included in a common tube envelope with a triode section acting as the first audio frequency amplifier. This is true for some receivers only, as the audio frequency amplifier may be in a separate tube. Tube 4 may be of the diode-triode type. The common cathode 51 is grounded, while the diode anode 5 is connected to the high potential side of the secondary circuit of transformer 3. Of course, the usual bypassed biasing resistor may be used in the cathode lead. The low side of the diode input circuit is connected to ground through a path comprising resistor 6 and a predetermined portion of resistor 7. The arm V of resistor 6 is slidable along resistor 7 to provide a volume control; a constant impedance to the grid 4' of the first audio frequency amplifier to ground is provided by this arrangement. The upper end of resistor 6 is bypassed to ground for I. F. currents by condenser 6'. The voltage drop developed due to rectified current flowing through resistor 6 is used as automatic volume control (AVC) bias. The actual load on the demodulator is a variable, and comprises resistor 6 plus that portion of resistor 7 between the movable arm V and ground.

As shown, the AVC lead 8 is arranged to be connected from the upper end of resistor 6 to the signal grids of the various controlled stages. The AVC lead includes filter resistor 9 to filter out all audio pulsating voltage components. The low potential side of the secondary circuit of transformer 2 is connected to the AVC lead. In the absence of received carrier energy there is no rectified current flowing through resistor 6 to ground. Hence, the AVC bias is zero, and the controlled stages have normal, maximum gain. When carrier energy is received, there is developed AVC bias which is applied in a negative, or gain-reducing, sense to the controlled amplifiers. Accordingly, the plate current of each controlled tube is substantially reduced.

I make use of this change in plate current of the I. F. amplifier tube 1 by inserting the winding of an electromagnet 10 in the circuit of plate P of amplifier tube 1. A pivoted, metallic armature 11, which is normally biased by spring 11', is provided to cooperate with the core of relay 10. The armature 11 will be pulled upward against the core of relay 10 when maximum plate current flows through tube 1. This occurs, of course, when no carrier energy is being received. When the AVC bias is produced carrier energy is being received, and, hence, the plate current flow through relay 10 will be insufficient to hold

the armature 11. Spring 11' will, therefore, pull the armature to its lowermost position.

The armature 11 cooperates with a pair of electrical contacts 12 and 13. A switch 16 consists of an adjustable arm which may be connected in one position to contact point 13, or it may be connected in a second position to contact point 12. Thus, when switch 16 is adjusted for connection to point 13 the receiver is in "carrier off" position. When the switch 16 is adjusted to be connected to point 12, then the receiver is in "carrier on" position. The switch arm 16 is connected by lead 18 to the control grid 4' of the triode section of tube 4. The control grid 4' may be connected to the cathode 5' by a grid leak resistor 6''. The plate 18' of the triode section of tube 4 is coupled, as by resistance-capacity coupling, to a following audio frequency amplifier 19 of conventional construction. Tube 19 comprises the cathode 19', grid 19'' and plate 14'. The output audio frequency transformer 20 may couple the plate circuit of audio frequency tube 19 to any desired type of reproducer, for example a loudspeaker. The audio frequency amplifier network is purely conventional, and need not be described in any further detail.

To provide a siren effect, there is connected an audio frequency feedback path from the circuit of plate 14' of audio frequency tube 19 to the pivoted end of armature 11. The audio frequency feedback path includes the condenser 14 which has a low impedance to audio frequency currents. The audio frequency input grid 4' of tube 4 is connected to the ungrounded end of resistor 7 by condenser 7'. In this way the audio frequency voltage component of the rectified I. F. current is applied to the control grid of tube 4.

In explaining the operation of the present invention, it is first pointed out that the spring tension on armature 11 is so adjusted that the relay is closed when no carrier is received. When signal carrier energy is applied to the receiver, the AVC action causes the plate current flowing through the relay coil to decrease. The relay 10 must be sensitive enough to operate on this change in current. The front and back contacts 13 and 12 of the relay are connected to the reversing switch 16, whose adjustable arm is connected to the input grid 4' of the first audio frequency amplifier.

With the switch 16 thrown to the front contact 13, a signal may be tuned in on the receiver and the audio frequency level in the speaker output adjusted to any desirable level, or turned down to sub-audible. The feedback circuit through the relay contacts is not complete due to the contacts being open. However, when the signal carrier is removed, the armature 11 will contact 13, and audio frequency feedback will be introduced through the condenser 14 from the last plate 14' to the amplifier grid 4'. The audio frequency system will oscillate, and cause a loud howl in the loudspeaker. If the switch 16 is now thrown to the contact 12 position, the howling will stop. Should the signal carrier come on again, the relay will operate and cause the howl to reappear. Thus, the relay 10 may be used to indicate that the carrier has been removed, or is being applied.

The volume control may be adjusted so that a fixed amount of resistance is present in the audio frequency grid circuit of the first audio frequency amplifier grid. In this way the setting of the volume control along resistor 7 has negligible effect on the audio frequency feedback. A bypass

condenser 17 shunts the I. F. current around the relay 10. The lead to the first audio grid may be shielded, as shown by the dotted line on either side of the lead from switch 16. Of course, when the receiver is being used for normal reception, the switch 16 will be adjusted to the contact 13 position. It is only when a black-out alarm is indicated by the loudspeaker, which is represented by the howling siren effect, that the switch 16 is adjusted to the contact 12 position. After such adjustment the reappearance of the howling indicates that the carrier has come on again. This is representative of an "all clear" signal.

It is not essential to the present invention that the feedback path be made to the first audio frequency amplifier. In Fig. 2 there is shown a modification wherein the audio frequency feedback is accomplished solely in the last audio frequency amplifier stage. It will be understood that the receiving system in this case is similar to that shown in Fig. 1, with the exception of the changes now to be described. The armature 11 is connected by lead 21 and iron core coil 22 to the grid 19' of audio frequency amplifier 19. The switch arm of switch 16 is connected by lead 18' to an intermediate tap on coil 22. The cathode 19'' of tube 19' is connected to the intermediate tap on coil 22 through a bypassed resistor 23. In this way the audio frequency amplifier 19 is caused to oscillate at an audio frequency. The contacts 12 and 13 are so connected that a portion of coil 22 is shorted out when oscillation is not desired thereby converting the tube to a simple impedance-coupled audio frequency amplifier.

If the receiver was tuned to, and receiving, a carrier, the switch arm 16 would be thrown to the lower (12) position. In this case the bottom half of the impedance 22 would be shorted out. The impedance 22 is for audio frequencies, and has an iron core. When the carrier is removed the I. F. plate current flowing through the relay coil 10 will increase. This will cause the relay armature to move to contact 13. Hence, the lower half of impedance 22 will be introduced bringing the cathode of tube 19 above ground so far as audio frequencies are concerned, and oscillations will be provided. The final tube 19 is a pentode, or beam, tube which has a screen grid 22' bypassed to ground for audio frequencies. Thus, considering the screen 22' of tube 19 as the plate of the oscillating circuit, there is provided a simple Hartley oscillator. The specific methods employed to produce the audio frequency oscillations is not limited to those shown; the invention broadly contemplates a carrier-controlled means for starting and stopping audio oscillations.

The electromagnetic relay 10 is merely illustrative. In place of such a relay there may be employed an electronic relay device. In Fig. 3 there is shown a modification of the invention wherein a vacuum tube 25, which is shown as of the triode type, has its plate 25' connected to the output circuit of audio frequency amplifier 19 through a variable resistor 26. The cathode 25'' of tube 25 is connected to ground through a choke coil 27. This coil 27 prevents the grid 4' of the first audio frequency amplifier from being grounded for audio frequency currents through condenser 30. The control grid G' of tube 25 is connected to the AVC line 8 through a filter resistor 28, the grid end of resistor 28 being connected to ground by condenser 29. The grid G' of relay tube 25 is biased by the voltage developed across the second detector load resistor 6. The cathode and plate of the relay tube 25 are connected to the input

grid 4' of the first audio frequency amplifier and to the plate of the last audio frequency tube 19 respectively. A direct current blocking condenser 30 is inserted in the path to the grid 4' of the first audio frequency tube. The variable resistor 26 controls the intensity of audio frequency feedback.

The electronic relay operates on the principle that the small voltage applied to the grid of relay tube 25 will cause large changes in the plate impedance of that tube. This variation in plate impedance is sufficient to start or stop oscillation, as it is placed in series with the feedback circuit. In other words, when carrier is being received there is a large negative bias on the grid G' of tube 25. This means that there is a large plate impedance in series in the audio frequency feedback circuit. Hence, there will be no audio frequency howling. On the other hand, when the carrier disappears the bias on the grid of tube 25 is a minimum, and the plate impedance thereof is very small thereby permitting howling to occur.

In Fig. 4 there is shown a modification of the arrangement shown in Fig. 3 wherein a different form of electronic relay is employed. The relay tube 31 has its cathode connected to ground, while the plate 32 is connected by lead 33 to the plate 18' of the first audio frequency amplifier. It will be noted that the plate of tube 4, the plate 32 and the screen grid 34 of tube 31 are energized from a common source of positive potential. Thus, the plate of tube 4 and screen grid 34 are connected by respective resistors 35 and 36 to the positive terminal of the energizing direct current source. The suppressor grid of the pentode type relay 31 is grounded. The plate 14' of audio frequency amplifier 19 feeds audio frequency energy to screen grid 34 through the direct current blocking condenser 37.

Audio frequency voltage is applied to the grid 4' of tube 4 by means of the adjustable potentiometer tap 40 which is slidable along a portion of the diode load. The AVC bias developed across load 41-42, which load is bypassed to ground for I. F. currents, is applied to the first grid 43 of relay tube 31. This embodiment involves less expensive parts, and has certain advantages over the triode relay shown in Fig. 3. For example, there exists better isolation and freedom from stray capacities through the relay tube so far as the feedback circuit is concerned. In this circuit the audio frequency feedback path is from the output of amplifier 19 to its grid circuit through tube 31. The AVC bias, which is a function of the carrier magnitude, varies the bias of grid 43, and, therefore, determines the plate impedance in the audio frequency feedback path. When the carrier disappears the plate impedance of tube 31 is a minimum, and audio frequency howling is produced. With the proper relay tube 31 and sufficient voltage from the demodulator, the latter depending upon the gain at the front portion of the receiver, the relay tube grid 43 will be biased sufficiently negative to prevent the feedback circuit from causing oscillations.

In Fig. 5 I have shown a further modification of the invention. In this modification the mechanical relay 10 is employed. The winding of the relay 10 is inserted in series with the load 41-42, the lower end of the winding being connected to ground. The audio frequency feedback path 50 is connected from the plate 14' of tube 19 to the spring-biased, pivoted armature 11. Switch 16 has its adjustable arm connected

through the direct current blocking condenser 54 to the grid 4' of tube 4. Adjustment of tap 40 varies the audio frequency voltage applied to the grid of tube 4. In the absence of received carrier energy there is no current flow through the winding of relay 10. Hence, the armature 11 is in contact with contact point 12. If switch 16 is adjusted to the contact 12 position, audio frequency howling takes place. By adjusting switch 16 to the contact 13 position, reappearance of the carrier causes howling again and signifies that the carrier has come on again.

It is to be understood that the relay device need not be operated from the I. F. amplifier, or from the second detector. It may be operated from any other point of the receiving system, as long as there is available a variation in either current or voltage due to the presence or absence of a received signal carrier. It is to be further understood that a special rectifier could be employed to operate the relay. Again, a less sensitive mechanical or electronic relay may be employed. In that case a direct current amplifier would be employed to increase the intensity of the variation control current or voltage. The relay could, also, be arranged to cause an auxiliary audio frequency oscillator, or other audible signal source, to feed into the audio frequency network of the receiver.

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 organizations 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. In combination with a radio receiver of the type including a demodulator, a succeeding audio frequency network and a reproducer, a carrier magnitude indication arrangement comprising a relay device responsive to the presence or absence of the signal carrier, means operatively associated with said audio network for providing an audio feedback network in the receiver thereby to cause an audible alarm signal to be emitted from said reproducer, and means responsive to said relay device for controlling said audio feedback.

2. In a radio receiver comprising at least one carrier amplifier, a demodulator, an audio frequency amplifier and a reproducer; the improvement which comprises a mechanical relay device connected to the carrier amplifier and arranged to be actuated by change in space current of said carrier amplifier, means responsive to carrier amplitude for controlling said space current, means providing an audio feedback circuit in said audio amplifier, and means responsive to said mechanical relay for completing said

audio feedback circuit thereby to cause an audio howl to be produced by said reproducer.

3. In combination with a signal carrier detector device provided with a load impedance across which is developed a voltage whose magnitude is a direct function of carrier magnitude, an audio frequency oscillation producing circuit, means for reproducing the audio oscillation, an electronic relay device whose impedance is a function of said carrier-derived voltage, and said electronic impedance being included in said audio oscillation circuit thereby to control said audio oscillations.

4. In combination with a carrier detector and an audio frequency network followed by a reproducer, means providing an audio feedback circuit in said audio network, a relay device having a circuit closing element thereof in said feedback circuit, means responsive to rectified voltage developed by said detector for controlling the relay device thereby to control said element, and a switch for selectively connecting said circuit-closing element in said feedback circuit for determining the completion of the audio feedback circuit with respect to the presence or absence of received carrier energy.

5. In a radio receiver comprising at least one carrier amplifier, a demodulator, an audio amplifier and a reproducer; the improvement which comprises a relay device connected to the carrier amplifier and adapted to be actuated by a change in space current of said carrier amplifier, means responsive to carrier amplitude for controlling said space current, means providing an audio feedback circuit in said audio amplifier, and means responsive to said relay for completing said audio feedback circuit thereby to cause an audio howl to be produced by said reproducer.

6. In combination with a signal carrier detector device provided with a load impedance across which is developed a rectified voltage whose magnitude is a function of carrier magnitude, an audio frequency oscillation producing circuit, means for reproducing the audio oscillations, an electronic device whose impedance is a function of said carrier-derived voltage, and said electronic device being included in said oscillation circuit thereby to control said oscillations.

7. In a radio warning receiver system provided with a regenerative audio frequency circuit and a reproducer for reproducing a warning tone characteristic of audio frequency oscillations produced by said regenerative circuit; the improvement comprising circuit-closing means in circuit with the regenerative circuit to control the effectiveness of the circuit, and additional means, responsive to the carrier amplitude of received carrier energy, for controlling the effect of said circuit-closing means.

JOHN R. SCHICK.