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NOISE SUPPRESSION CIRCUIT

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Fig. 1

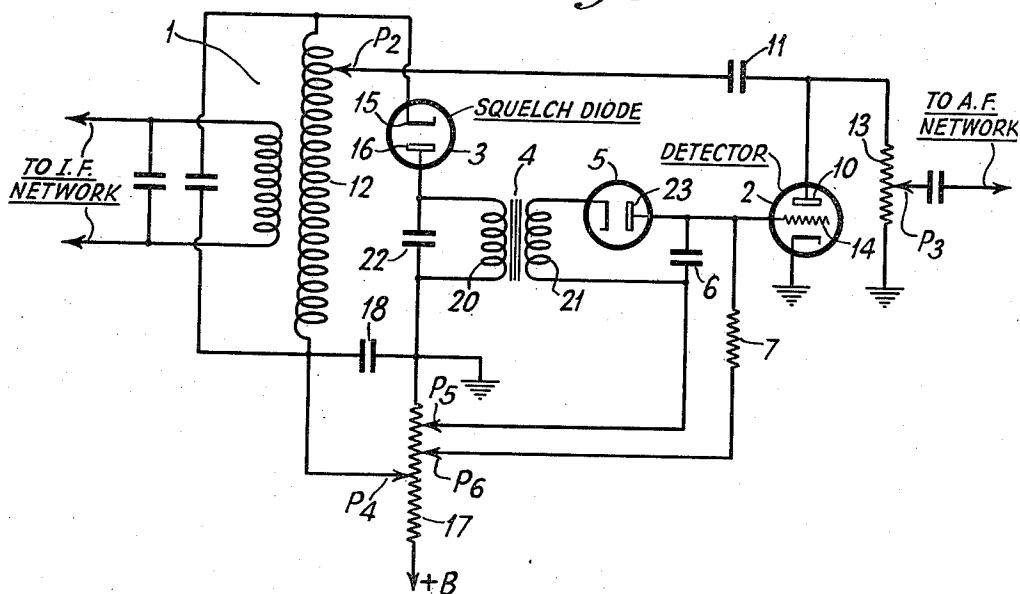
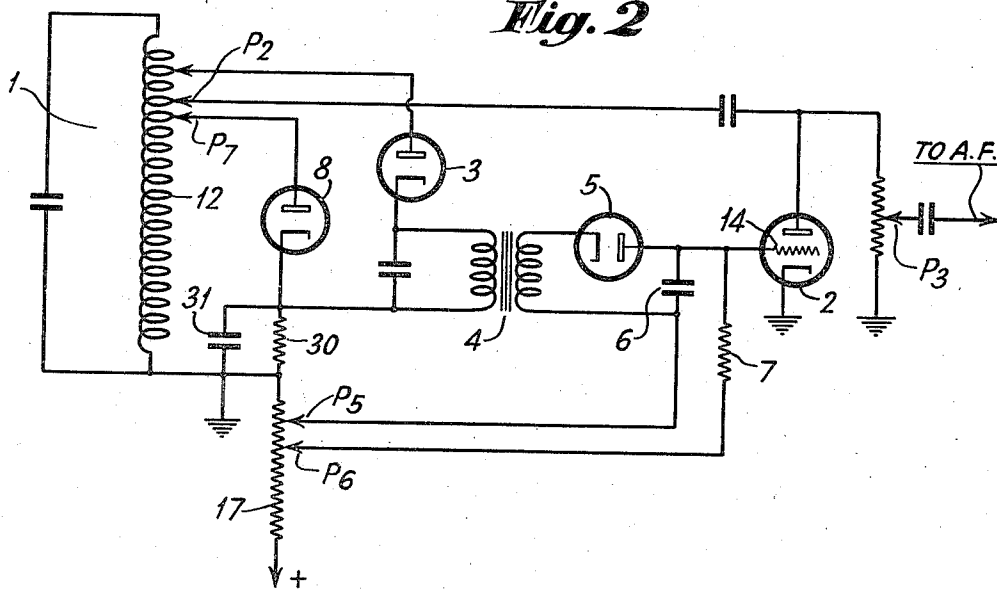


Fig. 2



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NOISE SUPPRESSION CIRCUIT

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10 Claims. (Cl. 250-20)

My present invention relates to the suppression of interfering noises, especially interfering noises characterized by short duration and relatively high amplitude.

5 Circuit arrangements are known in the art (for instance, U. S. Patents 2,115,876; 2,129,027; 2,135,949) for suppressing intermittent noise voltages whose amplitude is substantially in excess of the desired signal. This is done by developing
10 a bias potential proportional to said excess, and utilizing the bias potential to render the detector inoperative so long as the high amplitude noise continues. One drawback to circuits of this type lies in the fact that noise suppressing action cannot begin until the noise amplitude exceeds the
15 amplitude of the desired signal, for otherwise the signal itself would be partly suppressed.

The main object of the present invention is, therefore, to provide a noise silencing arrangement wherein the detector is rendered inoperative
20 by a voltage which is determined not only by the amplitude of an interfering noise impulse, but also by its rate of growth.

The novel features which I believe to be characteristic of my invention are set forth in particularity in the appended claims; the invention
25 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 circuit organizations whereby my invention may be carried into
30 effect.

In the drawing:

35 Fig. 1 illustrates one embodiment of the invention employing manual control of the threshold value of noise voltage at which suppression begins,

40 Fig. 2 shows a modification wherein the threshold value is automatically determined by the desired signal amplitude.

Referring now to the accompanying drawing, wherein like reference characters in the figures designate similar elements, Fig. 1 shows the second detector network of a superheterodyne receiver embodying the present invention. The circuit 1 is resonated to the operating intermediate frequency (I. F.), and is coupled to any
45 desired type of I. F. network for receiving its signal energy. The detector tube itself is a triode 2 whose plate, or anode, 10 is connected by condenser 11 to a desired point on the input coil 12. The cathode of tube 2 is at ground potential; the load impedance 13 is connected between the
50 anode and cathode of detector tube 2. Any de-

sired value of audio voltage may be tapped off from impedance 13 by the slidable tap P₃; the voltage can be utilized in any well known manner.

The cathode and anode of tube 2 provide a diode rectifier whose conductivity is regulated by
5 the grid 14. Control bias for grid 14 is developed by a so-called "squelch" diode 3. The latter has its cathode 15 connected to a point on coil 12. The anode 16 of diode 3 is connected to the positive potential terminal +B of a current source 10 (not shown) by a resistor 17. The anode end of resistor 17 is grounded for alternating currents; a direct current blocking condenser 18 connects the low potential end of coil 12 to the grounded end
15 of resistor 17. The cathode 15 of squelch diode 3 is adjustably biased positive by the slidable tap P₄ connected to resistor 17.

Rectified current flowing through diode 3 is transformed into a voltage proportional to the rate of change of input current. This is accomplished by the transformer 4, or equivalent inductive device, whose primary 20 is arranged in series between the anode 16 and ground; the radio frequency bypass condenser 22 being connected
25 across the primary. The secondary 21 is arranged in a series path comprising the space current path of diode 5, and condenser 6. The grid 14 of detector tube 2 is connected to anode 23 of diode 5. The adjustable tap P₅ is employed to provide normal positive bias for the cathode of diode 5. 30 The tap P₆ is used to adjust the normal bias for control grid 14; the resistor 7 being arranged in the lead to the grid.

The operation of this arrangement is as follows: In the absence of interference, tap P₄ is adjusted
35 to bias diode 3 sufficiently to prevent its drawing much current. It is permissible, however, for this bias to be adjusted to less than double the unmodulated carrier amplitude for reasons which will be pointed out subsequently. Assuming, now,
40 that interference in the form of an electric spark, such as from an automobile engine, sets up a transient oscillation in the intermediate frequency circuits of the receiver, the amplitude of this oscillation grows with extreme rapidity. Therefore, the
45 resulting rectified current flowing through the primary 20 of transformer 4 has a large rate of change, and induces a correspondingly large secondary voltage. The polarity of the winding of transformer 4 is so chosen that the valve diode 50 5 permits current to flow only as a result of voltage caused by increasing current through diode 3. When the aforementioned spark occurs, therefore, voltage induced in the secondary winding of transformer 4 overcomes the bias on valve 5, and
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produces a flow of current into condenser 6 thereby building up a negative charge on the grid 14 of detector 2.

The valve action of diode 5 prevents this charge from being withdrawn as the transient dies away and voltage of opposite sign is developed in the secondary of transformer 4. The negative charge thus impressed upon the grid not only paralyzes the detector tube during the time when the transient amplitude is increasing, but this charge dies out only after a length of time determined by the capacity of condenser 6 and the resistance of resistor 7. By a suitable choice of these constants the detector may be arranged to remain inoperative for a predetermined length of time which will be chosen sufficient to permit transients in the intermediate frequency circuits to die out. The normal bias on valve 5 will be so chosen that a slight amount of rectification can be permitted in the absence of noise voltage at diode 3 without developing enough voltage in the secondary of transformer 4 to overcome the bias on valve 5. This is because the modulation of the desired signal is relatively slow compared to the sudden building up of transients due to shock excitation. Hence, even though the amplitude of such a sudden transient may not exceed the amplitude of the signal, yet, due to its higher rate of change, it may still produce a squelching action while the normal signal itself will not.

In order to simplify the explanation of the invention separate electrodes have been shown for each of the various functions, but it will be understood that it is within the scope of the invention to use any type of detector, as well as a triode detector. It will, also, be apparent that a separate tube 3 may be dispensed with by placing the primary of transformer 4 in the circuit of the detector itself, although it is preferable to use a separate tube in order to limit its action to interfering voltages in excess of the unmodulated carrier.

Figure 2 shows an arrangement essentially similar to that of Fig. 1, except that the normal bias on diode 3 is produced by a further diode rectifier 8. The amount of this bias, as compared to the intermediate frequency voltage on diode 3, may be adjusted by the position of the tap P₇ on coil 12 of circuit 1 to which rectifier 8 is connected. For a given signal level the action of the circuit of Fig. 2 is the same as that of Fig. 1, and the only difference is that the bias on diode 3 adjusts itself automatically in accordance with the carrier voltage of the desired signal. The cathode of diode 3 is connected to the cathode end of resistor 30 arranged between the cathode of diode 8 and ground; a large condenser 31 being shunted across resistor 30.

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. A detector circuit including a detector tube and an input circuit, said tube having a cathode and cold electrode connected across said input circuit to provide rectification, means connected to the input circuit for rendering said detector tube inoperative, and said means including a control electrode, operatively associated with said cathode and anode to prevent said rectification,

when the rate of change of amplitude of the radio frequency wave at the input circuit applied to the detector tube exceeds a predetermined value greater than the maximum rate of change of amplitude due to modulation of the desired signal.

2. In a detection network including a detector tube, an input circuit, said tube including at least a cathode and anode coupled to said input circuit, means including a control grid located between the said cathode and anode for paralyzing the detector tube when the rate of change of amplitude of radio frequency voltage applied thereto from the input circuit exceeds a predetermined magnitude, and further means for maintaining the detector tube in inoperative condition for a predetermined length of time thereafter.

3. A detector circuit comprising a detector tube, a signal input circuit, said tube including at least a cathode and anode coupled to said input circuit, and means for rendering the detector tube inoperative by interference exceeding a predetermined amplitude relative to the amplitude of a desired signal and having a rate of increase greater than a predetermined value, said means including a control electrode operatively associated with said cathode and anode, a control circuit for said control electrode connected to said input circuit, and automatic means for maintaining said first named relation between signal amplitude and interfering amplitudes substantially constant.

4. In combination with a rectifier having a signal input circuit, said rectifier including a cathode and anode coupled to said input circuit, means, including an electrode positioned to control the space current flow between said cathode and anode, for controlling the conductivity of the rectifier, and means, responsive to an increase in the rate of change of amplitude of radio frequency voltage at the input circuit above a predetermined magnitude, for actuating said first means in a sense to render the rectifier non-conductive.

5. In a detector network having a tube provided with a cathode, anode and control grid, a signal input circuit connected to the cathode and anode for providing a rectifier circuit, a control circuit connected between said input circuit and said grid, said control circuit including a device which is responsive to an increase in the rate of change of amplitude of radio frequency voltage at the input circuit above a predetermined value.

6. A source of signals, a detector connected thereto, a rectifier connected to said source, said rectifier being biased to permit rectification only of signal voltage above a predetermined amplitude, means connected in the output circuit of said rectifier for developing a voltage proportional to the rate of increase of rectified current in said rectifier output, and a biased unidirectionally conducting valve device for applying said voltage to said detector to disable the latter only when said voltage exceeds a second predetermined magnitude.

7. In combination with a signal input circuit, a space discharge rectifier including a cathode and anode connected to points on said input circuit, a second rectifier coupled to said input circuit, a device of unidirectional conductivity, an inductive element coupling the second rectifier to said device, and means responsive to said

device for controlling the effectiveness of said first rectifier.

5 8. In combination with a signal input circuit, a space discharge rectifier including a cathode and anode connected to points on said input circuit, a control electrode for said rectifier, a second rectifier coupled to said input circuit, a device of unidirectional conductivity, an inductive element coupling the second rectifier to said device, and means responsive to said device for controlling the effectiveness of said first rectifier.

10 9. In combination with a signal input circuit, a space discharge rectifier including a cathode and anode connected to points on said input circuit, a second rectifier coupled to said input circuit, a device of unidirectional conductivity, an

inductive element coupling the second rectifier to said device, and means responsive to said device and connected to the control electrode for controlling the effectiveness of said first rectifier.

10. In combination with a signal input circuit, 5 a space discharge rectifier including a cathode and anode connected to points on said input circuit, a second rectifier coupled to said input circuit, a device of unidirectional conductivity, an inductive element coupling the second rectifier 10 to said device, means responsive to said device for controlling the effectiveness of said first rectifier, and a third rectifier coupled to the input circuit for controlling said second rectifier.

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