

PATENT SPECIFICATION

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(54) RADIO RECEIVER BLANKER GATE

(71) We, MOTOROLA, INC., a corporation organised and existing under the laws of the State of Delaware, United States of America, of Corporate Offices, Motorola Center, 1303 East Algonquin Road, Schaumburg, Illinois 60196, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:-

The present invention relates to a banker gate for coupling between first and second stages of a radio receiver.

Gating networks which provide a blanking function are well known in the radio receiver art. Such gates are normally series connected in the receiver chain thus providing a means to gate the received chain thus providing a means to gate the received signal in response to a blanking signal from the blanker.

Prior art blanking networks have, however, required engineering tradeoffs rendering a less than ideal blanking system. For example, since the blanker is inserted between two existing radio stages, impedance mismatches between the stages and the blanker gate may result in decreased signal transfer, and mistuning of the receiver, thereby reducing receiver sensitivity and signal to noise ratio. Since impedance matching to tuned stages normally implies a tuned network, tuned blankers have suffered from inadequate transient response. Fast turn-on and turn-off of a tuned circuit normally results in ringing which produces an annoying audible response from the receiver.

It is an object of this invention, therefore, to provide an improved blanker gate adapted for insertion in a conventional radio receiver design, which blanker gate provides proper impedance matching to the radio receiver stages while exhibiting superior transient response.

According to the invention there is pro-

vided a blanker gate for coupling between first and second stages of a radio receiver and responding to a blanking signal, comprising first and second matched transformers, each transformer having a primary winding and a secondary winding, the first transformer primary winding coupling signals from the first stage, the second transformer secondary winding coupling signals to the second stage, coupling means for coupling signals from the secondary winding of the first transformer to the primary winding of the second transformer, said coupling means including components of predetermined value to form with the transformers a filter having a predetermined characteristic response, and a blanking signal controlled switch means coupled in shunt with the coupling means and responsive to a blanking signal for preventing signals at the secondary of the first transformer from being coupled to the primary of the second transformer. The filter may be of the Butterworth type.

Briefly, in an embodiment of the invention the blanker gate uses first and second transformers to couple between the stages of the radio receiver. The primary winding of the first transformer couples signals from the first receiver stage and the secondary of the second transformer couples signals to the succeeding receiver stage. The transformers have balanced characteristics and, preferably, are bifilar wound. A coupling means, preferably comprised of selected value capacitors, couples signals from the secondary of the first transformer to the primary winding of the second transformer. The capacitors and transformers form a filter having a Butterworth response characteristic. Coupled in shunt across the coupling means, and therefore across the secondary of the first transformer and/or the primary of the second transformer is a signal controlled switch. In normal receiver operation the switch is inactivated whereby signals may

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pass freely between the receiver stages. However, upon receipt of a blanking signal the switch is activated thereby effectively decoupling signals from the first transformer to the second transformer and blanking the receiver. A preferably signal controlled switch includes two diode pairs, each pair having their diodes interconnected anode to anode, with the cathodes connected to each one of the free ends of the first transformer secondary winding and the second transformer primary winding. A blanking signal is applied to the common anode connections thus biasing the diodes to a conducting state and blanking the receiver. Due to the doubly balanced nature of the blanking gate, along with the symmetric arrangement of diodes, the blanking action occurs with a minimum of ringing. To further enhance the network's operation, a D.C. bias voltage may be applied to the diodes whereby in normal receiver operation they are actively biased to an off state, thus eliminating any effect of the diode on the circuit.

The invention will now be described by way of example only with particular reference to the accompanying drawing which shows the incorporation of the blanker gate in a conventional radio receiver.

The attached drawing is a schematic diagram for a radio receiver wherein radio frequency (RF) signals are picked up by an antenna 12 and routed both to an RF amplification stage 14 and to a blanker circuit 16. The blanker circuit 16 is of conventional design, generating blanking pulses in response to excessive noise on the antenna 12 input signal. A local oscillator 18 mixes with the output of the RF amplifier 14 in an F.E.T. mixer stage 20. The mixer stage 20 includes a source resistor 22 to ground, and a load in the drain which includes a tuned tank circuit 24, a decoupling resistor 27 and an RF bypass capacitor 28. Load resistor 27 connects to a source of DC bias. The mixer 20 acts in a conventional manner to modulate signals from the RF amplifier 14 by the local oscillator signal 18, thereby translating the RF received signal to an intermediate frequency. In a conventional receiver the output from mixer 20 would directly connect to an IF stage 26 which amplifies and filters the IF frequency and thereafter to a conventional detector 28' which demodulates the RF signal to baseband information. The detected signal from detector 28' is passed through an audio amplifier 30 and thereafter to a speaker 32 which transduces the recovered audio signal to audibility.

In this preferred embodiment of the invention, a blanker gate 40 has been inserted between the mixer stage 20 and the IF stage 26. It should be understood that the gate 40 might be inserted between any of a number of possible stages. The blanker gate 40 is

comprised of a pair of transformers 42, 44 each of which has a primary winding 42a, 44a and a secondary winding 42b, 44b, respectively. The first transformer 42 primary winding 42a is part of the tank circuit 24 in the mixer stage 20, and couples signals therefrom. For purposes of tuning the first transformer 42 to the selected IF passband, a capacitor 46 of selected value is supplied in shunt with the first transformer 42 primary winding 42a. In a similar manner, the second transformer 44 secondary winding 44b couples signals to the IF stage 26. To tune the second transformer 44 to the selected IF passband frequency, a shunt capacitor 48 is provided.

A pair of coupling capacitors 50, 52 connect the end of the first transformer 42 secondary winding 42b to the second transformer 44 primary winding 44a. The coupling capacitors 50, 52 are preferably of preselected value whereby the transformers 42, 44 and coupling capacitors 50, 52 form a bandpass filter having a Butterworth filter characteristic. As a result of the tuning of the transformers 42, 44 to their associated stages the blanker gate has a minimal effect on signals passed from the mixer stage 20 to the IF stage 26.

Switching to the gate 40 is provided by two diode pairs 56, 58. Each diode pair includes two diodes series connected with their anodes connected at a common point. The cathodes of the first diode pair 56 connect to the free end of the first transformer 42 secondary winding 42b. Similarly, the cathodes of the second diode pair 58 connect to the free ends of the second transformer 44 primary winding 44a. A pair of resistors 60, 62 feed from the blanker 16 output to the common anode connections of the diode pairs 56, 58, whereby a pulse from the blanker 16 forward biases the diodes to a conducting state and the first transformer 42 secondary winding 42b and second transformer 44 primary winding 44a are effectively shunted out. This, of course, prevents signals from being coupled through the blanker gate 40. When the diodes conduct, opposing current flows through the transformers 42, 44 such that the stored transformer energy due to diode current is reduced. With closely matched transformers, the amount of transformer stored energy is minimized, thereby minimizing the insertion of noise by the blanker gate upon receiving blanking pulses. Thus, the doubly balanced, tuned blanker gate network creates a minimum of ripple during turn-on and turn-off of the diode switching.

During the absence of a blanker pulse, it is preferable that the diode pairs 56, 58 can be turned off thereby eliminating any diode degradation to normal receiver operation. Proper turn off is provided by a biased resistor 66, one end of which connects to a source

of DC bias, with the remaining end connecting to the midpoints of the first transformer 42 secondary winding 42b and second transformer 44 primary winding 44a. The DC bias is provided through resistor 66 and filtered by an RF filter capacitor 68, acts to actively reverse bias the diode pairs 56, 58 in the absence of a blanking pulse, thereby driving them to a highly non-conductive state.

In summary, a blanker gate has been described which is adapted for insertion between two stages of a radio receiver. In the normal receiver mode the blanker gate provides minimal disturbance to the received signal. However, upon receiving a blanking signal, the blanker gate responds quickly while turning off with a minimum of ringing.

WHAT WE CLAIM IS:-

1. A blanker gate for coupling between first and second stages of a radio receiver and responding to a blanking signal, comprising first and second matched transformers, each transformer having a primary winding and a secondary winding, the first transformer primary winding coupling signals from the first stage, the second transformer secondary winding coupling signals from the secondary winding of the first transformer to the primary winding of the second transformer, said coupling means including components of predetermined value to form with the transformers a filter having a predetermined characteristic response, and a blanking signal controlled switch means coupled in shunt with the coupling means and responsive to a blanking signal for preventing signals at the secondary of the first transformer from being coupled to the primary of the second transformer.

2. The blanker gate according to claim 1, wherein the filter is of the Butterworth type.

3. The blanker gate according to claim 1 or claim 2, wherein the first and second transformers are bifilar wound.

4. The blanker gate according to claim 1, 2 or 3, wherein the coupling means comprises a pair of capacitors, each capacitor coupled between one end of the first transformer secondary winding and a corresponding end of the secondary transformer primary winding.

5. The blanker gate according to claim 4, wherein the capacitors are of predetermined value such that the transformers and the capacitors form said filter having a Butterworth characteristic.

6. The blanker gate according to any

preceding claim wherein the signal controlled switch means is comprised of a pair of diodes, the diodes being series connected with the anodes being connected at a common point, and with each of the cathodes being connected to one of the ends of the first transformer secondary winding.

7. The blanker gate according to any preceding claim wherein the signal controlled switch means is comprised of a pair of diodes, the diodes being series connected with the anodes being connected at a common point, and with each of the cathodes being connected to one of the ends of the second transformer primary winding.

8. The blanker gate according to any preceding claim in combination with a blanking means for generating a blanking signal and coupling the blanking signal to the signal controlled switch.

9. The blanker gate according to claim 6 or claim 7, in combination with a blanking means for generating a blanking signal and coupling the blanking signal to the common connection point of the diode pair, such that the blanking signal activates the diodes to a conducting stage.

10. The blanker gate according to any one of claims 6 to 9, wherein the blanker means further comprises a means for applying a DC bias potential at the centre point of the first transformer secondary winding for providing a bias to reverse bias the diodes to a non-conducting state in the absence of a blanking signal.

11. The blanker gate according to any preceding claim comprising a capacitor, coupled across the first transformer primary winding, for tuning the first transformer to a selected frequency range.

12. The blanker gate according to any preceding claim comprising a capacitor, coupled across the second transformer secondary winding for tuning the second transformer to a selected frequency range.

13. The blanker gate according to any preceding claim wherein the first stage is a mixer stage and the second stage is an intermediate frequency stage.

14. A blanker gate substantially as hereinbefore described and as shown in the figures of the accompanying drawing.

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of DC bias, with the remaining end connecting to the midpoints of the first transformer 42 secondary winding 42b and second transformer 44 primary winding 44a. The DC bias provided through resistor 66 and filtered by an RF filter capacitor 68, acts to actively reverse bias the diode pairs 56, 58 in the absence of a blanking pulse, thereby driving them to a highly non-conductive state.

In summary, a blanker gate has been described which is adapted for insertion between two stages of a radio receiver. In the normal receiver mode the blanker gate provides minimal disturbance to the received signal. However, upon receiving a blanking signal, the blanker gate responds quickly while turning off with a minimum of ringing.

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1. A blanker gate for coupling between first and second stages of a radio receiver and responding to a blanking signal, comprising first and second matched transformers, each transformer having a primary winding and a secondary winding, the first transformer primary winding coupling signals from the first stage, the second transformer secondary winding coupling signals from the secondary winding of the first transformer to the primary winding of the second transformer, said coupling means including components of predetermined value to form with the transformers a filter having a predetermined characteristic response, and a blanking signal controlled switch means coupled in shunt with the coupling means and responsive to a blanking signal for preventing signals at the secondary of the first transformer from being coupled to the primary of the second transformer.

2. The blanker gate according to claim 1, wherein the filter is of the Butterworth type.

3. The blanker gate according to claim 1 or claim 2, wherein the first and second transformers are bifilar wound.

4. The blanker gate according to claim 1, 2 or 3, wherein the coupling means comprises a pair of capacitors, each capacitor coupled between one end of the first transformer secondary winding and a corresponding end of the secondary transformer primary winding.

5. The blanker gate according to claim 4, wherein the capacitors are of predetermined value such that the transformers and the capacitors form said filter having a Butterworth characteristic.

6. The blanker gate according to any

preceding claim wherein the signal controlled switch means is comprised of a pair of diodes, the diodes being series connected with the anodes being connected at a common point, and with each of the cathodes being connected to one of the ends of the first transformer secondary winding.

7. The blanker gate according to any preceding claim wherein the signal controlled switch means is comprised of a pair of diodes, the diodes being series connected with the anodes being connected at a common point, and with each of the cathodes being connected to one of the ends of the second transformer primary winding.

8. The blanker gate according to any preceding claim in combination with a blanking means for generating a blanking signal and coupling the blanking signal to the signal controlled switch.

9. The blanker gate according to claim 6 or claim 7, in combination with a blanking means for generating a blanking signal and coupling the blanking signal to the common connection point of the diode pair, such that the blanking signal activates the diodes to a conducting stage.

10. The blanker gate according to any one of claims 6 to 9, wherein the blanker means further comprises a means for applying a DC bias potential at the centre point of the first transformer secondary winding for providing a bias to reverse bias the diodes to a non-conducting state in the absence of a blanking signal.

11. The blanker gate according to any preceding claim comprising a capacitor, coupled across the first transformer primary winding, for tuning the first transformer to a selected frequency range.

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