

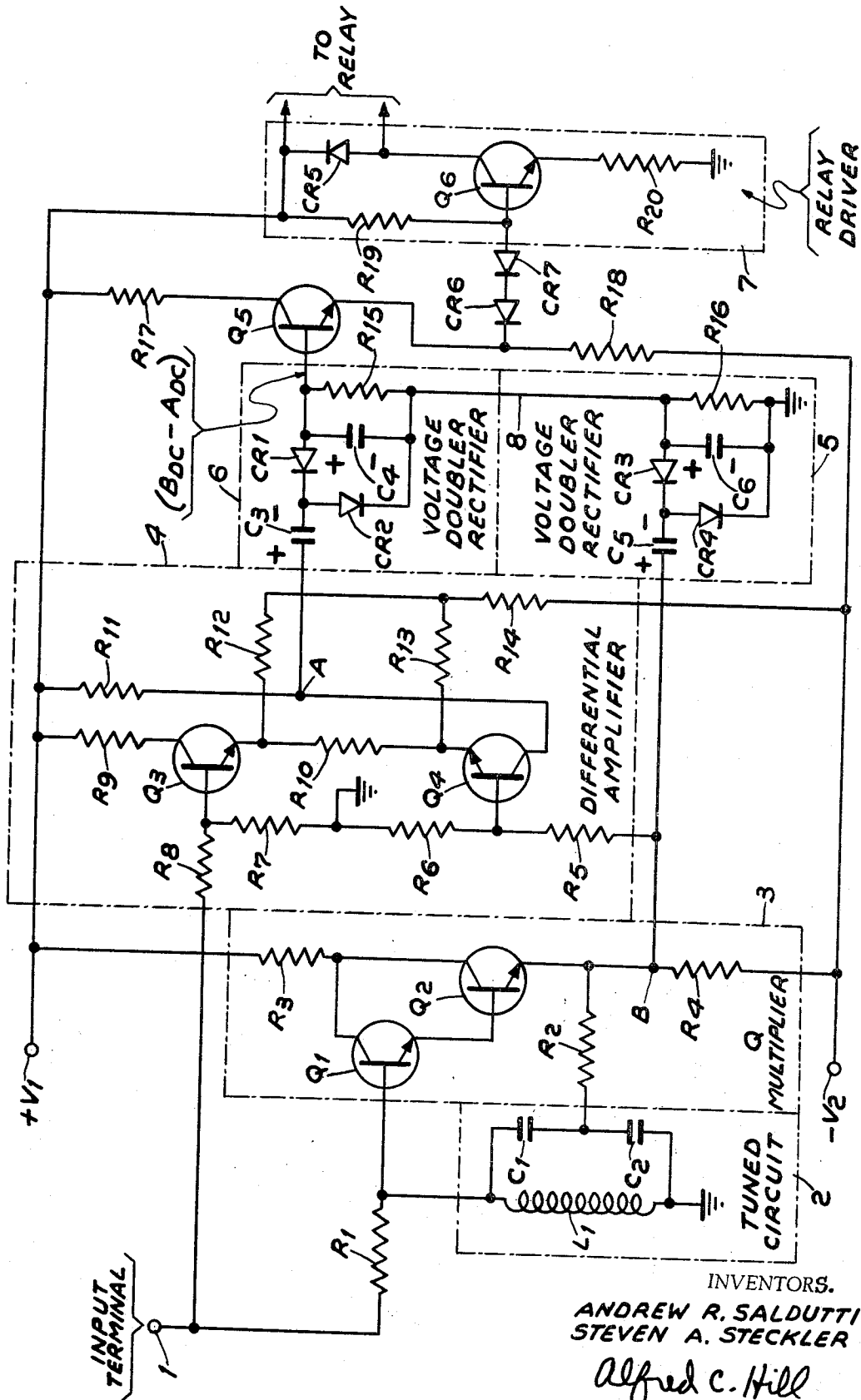
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TONE DETECTOR

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TONE DETECTOR

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9 Claims

ABSTRACT OF THE DISCLOSURE

A Q multiplier increases the Q of a LC circuit tuned to frequency F and provides a peaked output for an input tone having a frequency F. The peaked output and the given input tone are subtracted from each other by a differential amplifier providing a null output. The peaked output and the null output are rectified and combined producing an output. An input tone having a frequency other than F will produce an output from the differential amplifier which will prevent the production of the output.

BACKGROUND OF THE INVENTION

This invention relates to communication systems and more particularly to a tone detector for communication systems employing a tone having a single given frequency for conveying information.

A tone having a single given frequency can be employed in many types of communication systems to convey intelligence. For instance, the tone can be keyed at a control center with an order to operate apparatus at a remote point. In another system, the tone can be keyed in accordance with meter readings, or the like, to enable a control center to read a meter disposed at a point remote from the control center. In an order wire system, a tone disposed in the voice band can be utilized for address purposes to prepare a remote terminal for receipt of voice information.

In all such systems, it is necessary to provide a detector for the tone conveying the information which is nonresponsive to spurious tones and/or voice intelligence. In the past such detectors have employed two large, high Q tuned circuits.

SUMMARY OF THE INVENTION

An object of this invention is to provide an improved tone detector for utilization in communication systems of the type described above and the like.

Another object of this invention is to provide a tone detector employing a single, relatively low Q tuned circuit.

Still another object of this invention is to provide a tone detector employing components of reduced size.

A further object of this invention is to provide a tone detector that may be manufactured employing microelectronic techniques.

A feature of this invention is the provision of a detector for a tone having a given frequency comprising an input terminal, a tuned circuit coupled to the input terminal, the tuned circuit being tuned to the given frequency and having a given value of Q, first means coupled to the tuned circuit to increase the value of Q, and second means coupled to the input terminal and the first means to produce an output in response to an input tone having a given frequency and no output in response to input tones having frequencies other than the given frequency.

BRIEF DESCRIPTION OF THE DRAWINGS

The above mentioned and other features and objects of this invention will become more apparent by reference to the following description taken in conjunction with the

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accompanying drawing, in which the single figure of the drawing is a schematic diagram of a tone detector in accordance with the principles of this invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the figure, the detector of this invention includes input terminal 1 to which tuned circuit 2 is coupled, circuit 2 being tuned to the frequency of the tone which is desired to be detected and having a relatively low value of Q. Q multiplier 3 coupled to tuned circuit 2 increases the Q of the tuned circuit by a given factor, for instance, by a factor of 10. One input of differential amplifier 4 is coupled to terminal 1 and the other input of differential amplifier 4 is coupled to point B, the output of Q multiplier 3. The output of Q multiplier 3, point B, is coupled to voltage doubler rectifier 5 and the output of differential amplifier 4, point A, is coupled to a second voltage doubler rectifier 6. The outputs of the voltage doubler rectifiers 5 and 6 are combined to produce a control voltage ($B_{DC}-A_{DC}$) which is used to control the conduction of relay driver 7 through the means of the circuitry including transistor Q5.

More specifically, tuned circuit 2 includes inductance L1 and capacitors C1 and C2. Tuned circuit 2 is coupled to terminal 1 by resistor R1. The Q multiplier includes transistor Q1 having its base coupled to resistor R1 with its emitter electrode coupled to the base electrode of transistor Q2. The collectors of transistors Q1 and Q2 are coupled to a positive voltage +V1 by resistor R3. The emitter of transistor Q2 is coupled to the junction of capacitors C1 and C2 by resistor R2 and also by load resistor R4 to a negative voltage -V2.

Differential amplifier 4 includes transistors Q3 and Q4 and their associated interconnecting resistors R6, R7, R9, R10, R12, R13 and R14. Resistor R8 provides one input for the differential amplifier and is coupled between terminal 1 and the base of transistor Q3. Resistor R5 constitutes the other input for differential amplifier 4 and is coupled between point B and the base of transistor Q4. Resistor R11 constitutes the load resistor for the differential amplifier 4 and provides an output therefrom at point A. Point A is coupled to voltage doubler rectifier 6 which includes the coupling capacitor C3, diodes CR1 and CR2, capacitor C4 and load resistor R15. The output of Q multiplier 3, point B, is coupled to voltage doubler rectifier 5 which includes the coupling capacitor C5, diodes CR3 and CR4, capacitor C6 and load resistor R16. The rectifier 5 has its load resistor R16 coupled to ground and interconnected to R15 of rectifier 6 by conductor 8 to provide the control voltage ($B_{DC}-A_{DC}$) at the base of transistor Q5. The collector of transistor Q5 is coupled to the positive +V1 voltage by resistor R17 and the emitter of transistor Q5 is coupled to the negative supply voltage -V2 by resistor R18. The emitter of transistor Q5 is coupled to the base of transistor Q6, a part of relay driver 7, by means of diodes CR6 and CR7. The base of transistor Q6 is coupled to the +V1 voltage by resistor R19 and the emitter of transistor Q6 is coupled to ground by resistor R20. The collector of transistor Q6 is coupled to +V1 by diode CR5 while the collector is directly coupled to a relay (not shown) along with the +V1 supply voltage.

The operation of the detector in accordance with this invention is to provide an output indication when a tone is present having a frequency equal to the frequency at which tuned circuit 2 is tuned, in other words, at a frequency

$$F = \frac{1}{2\pi\sqrt{LC}}$$

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When the tone of the given frequency is present, Q multiplier 3 provides a peak output across resistor R4 at point B. Also, the output of the differential amplifier 4 provides a null output across resistor R11 at point A when the given tone is present. After being rectified in rectifiers 5 and 6 there is a control voltage of substantially $+B_{DC}$ at the base of transistor Q5 which will render this transistor and transistor Q6 of relay driver 7 conductive to operate the relay and give an indication of the receipt of the tone and enable detection of the information contained thereon. When any other signal having a frequency different than F is applied to terminal 1 there will be substantially no output across resistor R4 at point B and there will be a substantial negative output across resistor R11 at point A resulting in a $-A_{DC}$ control voltage on the base of transistor Q5 which will drive this transistor into cut off and render transistor Q6 of relay drive 7 nonconductive and, thus, the relay inoperative.

Therefore, in the arrangement of the tone detector of this invention the detector will respond to a tone having a frequency F but will be nonresponsive to signals (voice frequencies) or tones of any other frequency.

Due to the size and type of components employed in the tone detector of this invention this tone detector lends itself to manufacturing by utilizing microelectronic techniques and, therefore, will provide a relatively small modular unit to be employed in communication systems wherein a tone of a single given frequency is employed for conveying intelligence.

While we have described above the principles of our invention in connection with specific apparatus, it is to be clearly understood that this description is made only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the accompanying claims.

We claim:

1. A detector for a tone having a given frequency comprising:

an input terminal;

a tuned circuit coupled to said input terminal, said tuned circuit being tuned to said given frequency and having a given value of Q;

first means coupled to said tuned circuit to increase said value of Q;

differential amplifier means coupled to said input terminal and said first means to subtract the output signal of said first means and the input tone; and second means coupled to said differential amplifier means and said first means to produce a finite output signal in response to an input tone having said given frequency and no output signal in response to input tones having frequencies other than said given frequency.

2. A detector according to claim 4, wherein said tuned circuit is an LC tuned circuit having a relatively low value of Q.

3. A detector according to claim 4, wherein said first means includes a Q multiplier.

4. A detector for a tone having a given frequency comprising:

an input terminal;

a tuned circuit coupled to said input terminal, said tuned circuit being tuned to said given frequency and having a given value of Q;

first means coupled to said tuned circuit to increase said value of Q; and

second means coupled to said input terminal and said first means to produce an output in response to an input tone having said given frequency and no output in response to input tones having frequencies other than said given frequency;

said second means including;

third means coupled to said input terminal and

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said first means to subtract the output of said first means and the input tone,

a first rectifier means coupled to said first means,

a second rectifier means coupled to said third means,

a fourth means coupled to said first and second rectifier means to combine the rectified outputs therefrom to produce a control signal,

output means for said detector, and

fifth means coupled between said fourth means and said output means responsive to said control signal to control and the production of an output from said output means.

5. A detector according to claim 4, wherein said third means includes:

a differential amplifier.

6. A detector according to claim 4, wherein

each of said first and second rectifier means include: a voltage doubler rectifier.

7. A detector according to claim 4, wherein

said output means includes:

a relay driver whose conduction is controlled by said fifth means.

8. A detector for a tone having a given frequency comprising:

an input terminal;

a tuned circuit coupled to said input terminal, said tuned circuit being tuned to said given frequency and having a given value of Q;

first means coupled to said tuned circuit to increase said value of Q; and

second means coupled to said input terminal and said first means to produce an output in response to an input tone having said given frequency and no output in response to input tones having frequencies other than said given frequency;

said tuned circuit being an LC tuned circuit having a relatively low value of Q;

said first means including:

a Q multiplier; and

said second means including:

third means coupled to said input terminal and said Q multiplier to subtract the output of said Q multiplier and the input tone,

a first rectifier means coupled to said Q multiplier,

a second rectifier means coupled to said third means,

fourth means coupled to said first and second rectifier means to combine the rectifier outputs therefrom to produce a control signal,

output means for said detector, and

fifth means coupled between said fourth means and said output means responsive to said control signal to control the production of an output from said output means.

9. A detector according to claim 8, wherein

said third means includes:

a differential amplifier;

each of said first and second rectifier means include:

a voltage doubler rectifier; and

said output means includes:

a relay driver whose conduction is controlled by said fifth means.

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