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(54) **Audible warning devices**

(57) An audible warning device e.g. for a fire alarm system is arranged to generate an audible output signal having a first frequency 1/T1 and comprises an audible output transducer 10 and a driver circuit 12 for applying an alternating drive signal, having a second and higher frequency 1/T2, to the transducer 10 over successive distinct periods, the frequency of the periods being equal to the first frequency 1/T1. The (second) frequency at which the transducer 10 is driven is at or near the resonant frequency of the transducer 10. However, the (second) frequency signal is only applied in successive distinct periods at the (first) lower frequency and thus the transducer appears to produce an audible output signal at this lower frequency.

There is also disclosed a method of tuning the a transducer to output an audible output signal at the (first) lower frequency by determining the (second) frequency at which the audible output of the transducer is high and driving the transducer 10 with a drive signal at the determined (second) frequency over successive distinct periods, the frequency of the periods being equal to the desired (first) frequency.

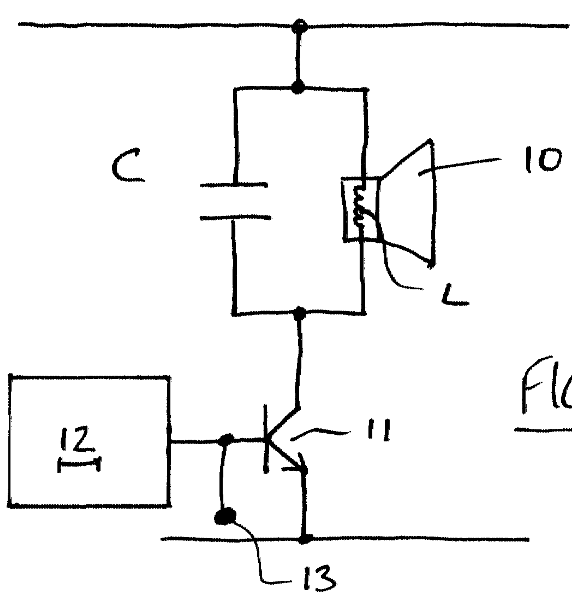

FIGURE 1

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Description

[0001] This invention relates to audible warning devices and more particularly but not solely to audible warning devices for alarm systems.

[0002] Audible warning devices are known which comprise an audible transducer such as a loudspeaker or piezo transducer and a driver circuit which applies an alternating voltage to the transducer thereby causing the transducer to output an audible signal at the frequency of the applied voltage. It is often a characteristic of such transducers and their associated components that the outlet level according to the frequency of the applied voltage.

[0003] In fire alarm systems there is a requirement that the output frequency of the warning signal generated by the devices is in the range of 500-1000Hz. However, a disadvantage of this is that the output level of the transducers used in the devices is often low when the transducers are driven with an alternating voltage in this frequency range.

[0004] This problem can be overcome by driving the transducers with a higher voltage but this has the effect of increasing power consumption and the level of the applied signal is ultimately constrained by the performance of the power supply.

[0005] We have now devised an audible warning device which alleviates the above mentioned problems.

[0006] In accordance with this invention, as seen from a first aspect, there is provided an audible warning device arranged to generate an audible output signal having a first frequency, the device comprising an audible output transducer and a driver circuit for applying an alternating drive signal, having a second and higher frequency, to the transducer over successive distinct periods, the frequency of the periods being equal to said first frequency.

[0007] In this manner the transducer can be driven by an alternating voltage having a frequency equal to a frequency at which the output of the transducer would normally be high. However, because the alternating voltage is only applied in successive distinct periods of a lower frequency, the transducer appears to produce an output signal at this lower frequency.

[0008] Accordingly, the device is able to meet the requirements for a fire alarm system but yet produces a high output level.

[0009] In one embodiment, the driver circuit outputs successive groups of positive or negative going pulses at said first lower frequency, the pulses being output at said second higher frequency.

[0010] In an alternative embodiment, the driver circuit outputs successive groups of successive positive and negative going pulses at said first lower frequency, the pulses being output at twice said second higher frequency.

[0011] In the latter embodiment the successive positive or negative going pulses in the group are output at the second higher frequency. Driving the transducer with successive positive and negative going pulses helps to establish rapid oscillations at resonant frequency in an inductive transducer connected as a part of a tuned circuit.

[0012] We have found that the frequency at which the output level of identical transducers is maximised varies between transducers owing to differences in manufacturing and component tolerances.

[0013] In order to overcome this problem we have devised a method of maximising the sound output level of an audible warning device.

[0014] Thus, in accordance with this invention, as seen from a second aspect, there is provided a method of maximising the sound output level of an audible warning device at a desired frequency, comprising the steps of:

a) applying a variable frequency signal to a transducer of the device;
b) monitoring the sound output level of the transducer;
c) determining a frequency at which the ratio of the output level to the applied signal is high; and
d) driving the transducer with a drive signal at the determined frequency over successive distinct periods, the frequency of the periods being equal to the desired frequency.

[0015] The above method is carried out following manufacture of the device. It will be appreciated that a number of devices each having different sound output characteristics will each emit sound at exactly the same frequency.

[0016] An embodiment of this invention will now be described by way of example only and with reference to the accompanying drawings, in which:

FIGURE 1 is a schematic diagram of an audible warning device in accordance with this invention; and
FIGURES 2A-C are waveform diagrams to explain the operation of the device of Figure 1.

[0017] Referring to Figure 1 of the drawings, there is shown an audible warning device of the type used in a fire alarm system to warn when an alarm condition is triggered.

[0018] The device comprises an audible transducer 10 of the type disclosed in British patent application No. 2 106 748 having an inductive coil L which vibrates an armature when an alternating electric current is passed therethrough. The coil L is connected across a capacitor C to form a tuned circuit.

[0019] The upper arm of the tuned circuit is connected to the positive voltage rail +v and its lower arm is connected to the zero volts rail 0v via a switching device such as an npn bipolar transistor 11.

[0020] The capacitance value of the tuned circuit is chosen so that the resonant frequency of the circuit is at or near the frequency at which the output of the transducer is known to be high compared with the voltage across the coil L. However, in practice the actual frequency value at which the maximum sound output is produced varies from transducer to transducer owing to slight differences in mechanical and electrical characteristics.

[0021] Following manufacture of the device, a variable frequency test signal is applied to terminal 13 and the sound output level of the transducer is monitored to determine the frequency at which the output level is maximised. This frequency is recorded and entered into a microprocessor 12 connected to the base of the transistor 11. The microprocessor 12 is also programmed with the desired frequency at which the transducer 10 is to emit sound.

[0022] Referring to Figure 2 of the drawings, in use the microprocessor 12 outputs a waveform A comprising successive positive and negative going pulses 14,15, with the frequency (1/T2)of the waveform being equal to the determined frequency at which the output level of the transducer 10 is maximised.

[0023] The pulses 14,15 induce oscillations in the tuned circuit LC, such that a voltage waveform B is applied across the coil L.

[0024] The microprocessor 12 is arranged to output the waveform A over successive distinct periods, with the frequency (1/T1) of the periods being equal to the desired audio output frequency of the transducer 10.

[0025] In this manner, a perception is given that the transducer 10 is outputting a waveform C at the desired audio output frequency but yet the transducer 10 is being driven with the higher frequency at which its output is maximised.

[0026] If necessary, the microprocessor may vary the frequency (1/T1) at which the groups of pulses are emitted, so that a sweeping or pulsed audio output signal is generated.

[0027] Also, the width of the generated pulsed 14,15 may be varied to vary the amount of power delivered to the transducer.

Claims

1. An audible warning device arranged to generate an audible output signal having a first frequency, the device comprising an audible output transducer and a driver circuit for applying an alternating drive signal, having a second and higher frequency, to the transducer over successive distinct periods, the frequency of the periods being equal to said first frequency.

2. An audible warning device as claimed in claim 1, in which the driver circuit outputs successive groups of positive or negative going pulses at said first lower frequency, the pulses being output at said second higher frequency.

3. An audible warning device as claimed in claim 1, in which the driver circuit outputs successive groups of successive positive and negative going pulses at said first lower frequency, the pulses being output at twice said second higher frequency.

4. An audible warning device as claimed in claim 3, in which the successive positive or negative going pulses in the group are output at the second higher frequency. Driving the transducer with successive positive and negative going pulses helps to establish rapid oscillations at resonant frequency in an inductive transducer connected as a part of a tuned circuit.

5. A method of maximising the sound output level of an audible warning device at a desired frequency, comprising the steps of:

   a) applying a variable frequency signal to a transducer of the device;
   b) monitoring the sound output level of the transducer;
   c) determining a frequency at which the ratio of the output level to the applied signal is high; and
   d) driving the transducer with a drive signal at the determined frequency over successive distinct periods, the frequency of the periods being equal to the desired frequency.

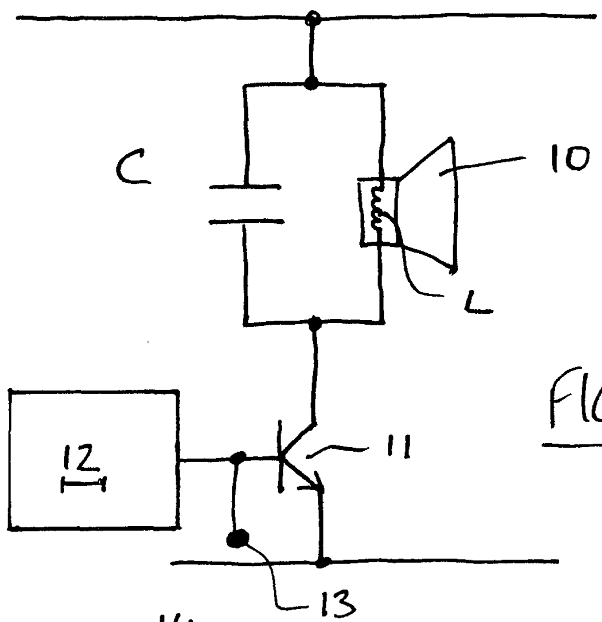

FIGURE 1

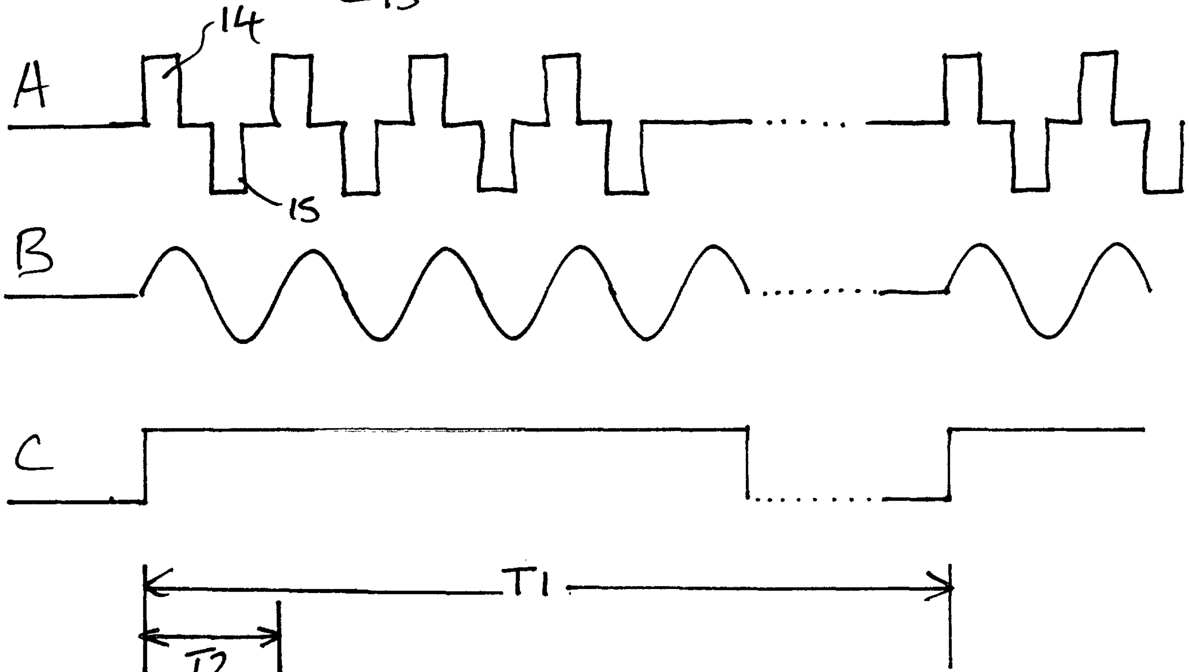

FIGURE 2