





## AUDIBLE ALARM DEVICE

Generally speaking the present invention relates to an audible alarm device comprising a tone generator means including a piezoelectric transducer, a pulsator means connected to the tone generator means, a transient protection means connected to the pulsator means and the tone generator means, and an input-output terminal means connected to the transient protection means and to the tone generator means. he The

Embodiments of the present invention may be utilized in many applications where an audible alarm is required. The illustrated embodiment of the present invention is adapted to provide a variety of audible alarm sounds in response to electrical signals produced within an automobile. For example, this embodiment can provide one tone to indicate that seat belts are not fastened, another tone to remind the driver that his keys are in the ignition when he opens a door, and another tone to warn the driver that the is speeding. the tones may be continuous or pulsing.

Audible alarm devices are well known in automobile applications to warn a driver of a potential problem or alert him of a situation requiring immediate attention. Many of these alarms are in the form of electromagnetic buzzers, and one buzzer is normally required for each warning signal required. In recent years, more and more warnings are being required in automobile applications.

Locating several buzzers in a car can be difficult. For a driver to recognize one buzz from another, the buzzers are sometimes separated so that, for example, a speedometer speed warning signal comes from his left and a "fasten seat belt" signal can be heard from his right. The present invention eliminates this location problem by providing one alarm device centrally located. The transducer signals, each indicating a different warning, are distinguishable because they differ in rate of pulsing.

Another problem associated with electromagnetic buzzers is their inherently unpleasant sound. This buzzer noise is sometimes a dangerous distraction to a driver of an automobile. The present invention solves this problem by utilizing a piezoelectric transducer which produces a pleasing audible tone.

Another problem involved with locating a number of electromagnetic buzzers, each for a different signal, throughout an automobile is the cost of the wiring to each of the buzzers, the cost of installation labor, and the cost of the necessary support equipment, such as electric connectors and mounting brackets. The present invention provides a piezoelectric transducer audible alarm which, in an automobile may replace three electromechanical buzzers in one neat and very compact package — a package that can be easily and quickly plugged into place or unplugged for service.

Accordingly, a feature of the present invention is to provide an audible alarm device utilizing a piezoelectric transducer. Another feature of the present invention is to provide an audible alarm device including an integrated circuit package. Another feature of the present invention is to provide an audible alarm device including a transient protection means. Another feature of the present invention is to provide an audible alarm device incorporating a Quad two-input NAND gate integrated circuit package. Another feature of the present invention is to provide an audible alarm device for

use in an automobile to alert the driver to various situations requiring his attention.

These and other features will become more apparent from the following description taken in conjunction with the accompanying drawing wherein there is shown a wiring diagram of an embodiment of an audible alarm device utilizing a piezoelectric transducer and a Quad two-input NAND gate integrated circuit package.

Referring now to the drawing, an audible alarm device 10 comprises a tone generator means 12, including a piezoelectric transducer 14, a pulsator means 16 connected to tone generator means 12, a transient protection means 18 connected to pulsator means 16 and tone generator means 12, an input-output terminal means 20 connected to transient protection means 18, and a ground isolation means 22 connected to tone generator means 12, transient protection means 18, and input-output terminal means 20.

Ground isolation means 22, for providing more than one ground path to device 10, is connected directly to transient protection means 18 and input-output terminal means 20 and also is connected through a resistance means 24 to both transient protection means 18 and input-output terminal means 20.

Input-output terminal means 20 for providing electrical terminations to the device 10 includes terminations 28, 30, 32, and 34. Termination 28 is connected to ground isolation means 22, and a first side of resistance means 24. Termination 30 is connected to voltage transient protection means 18 and to a second side of resistance means 24. Termination 32 is connected to voltage transient protection means 18. Termination 34 is connected to voltage transient protection means 18 and ground isolation means 22. A resistance means 26 is connected between termination 32 and 34.

Pulsator means 16 for producing pulsations in an audible tone incorporates two two-input NAND gates 36 and 38 of a Quad two-input NAND gate integrated circuit package 40. One such integrated circuit package 40 is incased in a 14 terminal dual-in-line plastic module manufactured by National Semiconductor Company of Santa Clara, Calif. An input 42 of gate 36 is connected to voltage transient protection means 18, and another input 44 of gate 36 is connected to a first side of a resistance means 46. An input 47 of gate 38 is connected to voltage transient protection means 18. Another input 48 of gate 38 is connected to a first side of a resistance means 50 and to an output 54 of gate 36. An output 56 of gate 38 is connected to tone generator means 12 and to a first side of a capacitance means 52. A second side of resistance means 46 is connected to a second side of resistance means 50 and to a second side of capacitance means 52.

Tone generator means 12 for producing an audible tone incorporates two two-input NAND gates 58 and 60 of the Quad two-input NAND gate integrated circuit package 40. Piezoelectric transducer 14 includes electrodes 62, 70 and 76. Electrode 62 is connected to ground isolation means 22. An input 64 of NAND gate 58 and an input 80 of NAND gate 60 are connected to pulsator means 16. An input 66 of NAND gate 58 and an input 78 of NAND gate 60 are connected to a first side of a resistance means 68 and to electrode 70 of piezoelectric transducer 14. An output 72 of NAND gate 58 and an output 82 of NAND gate 60 are connected to a second side of resistance means 68 and through a resistance means 74 to electrode 76 of transducer 14.

Ground isolation means 22 includes diodes 84 and 86. The anodes of diodes 84 and 86 are connected together and to the tone generator means and to a minus voltage terminal 106 of integrated circuit package 40. A cathode of diode 84 is connected to termination 28 of input-output terminal means 20 and through resistance means 24 to termination 30. A cathode of second diode 86 is connected to termination 34 and to transient protection means 18.

Transient protection means 18 for protecting device 10 against electrical transient voltages includes three resistance means 100, 102, 103. Resistance means 100 is connected between termination 30 and input 42 of first NAND gate 36. Resistance means 102 is connected between termination 32 and a plus voltage terminal 104 of integrated circuit package 40. Resistance means 103 is connected between termination 34 and input 47 of second NAND gate 38.

A minus voltage terminal pin 106 of integrated circuit package 40 is connected to electrode 62 of piezoelectric transducer 14 and to ground isolation means 22.

A typical application for audible alarm device 10 is an automobile to produce audible signals to alert a driver to situations requiring his attention. The FIG. illustrates a portion of a typical automobile electrical circuit 88 connected to audible alarm device 10. A DC power supply 90, which may comprise an automotive battery 92 is connected positive terminal 96 to termination 32 of circuit 10 and negative terminal 98 to ground 94. Two single-pole single-throw switches S1 and S2 are connected in series between termination 30 of circuit 10 and positive terminal 96 of DC power supply 90. Another single-pole single-throw switch S3 is connected between termination 28 of circuit 10 and ground 94. Two more single-pole single-throw switches S4 and S5 are connected in series between termination 34 of circuit 10 and ground 94. A single-pole single-throw switch S6 is also connected between termination 34 and ground 94.

In one application switches S1 through S6 may have these relationships to other automotive components: switch S2 is included in an ignition switch to be switched when the ignition switch is activated; switch S1 is included in a gear shift lever so as to be switched in preselected positions of the lever such as drive; switch S3 is included in a seat belt interlock module and is responsive to fastening or unfastening of the seat belt; switch S4 is incorporated in an ignition lock (separate from switch S2) to be switched upon insertion or withdrawal of ignition key; switch S5 is located in a passage doorway in such a manner as to be switched upon opening and closing of the door; and switch S6 is incorporated in a speedometer to be switched at preselected positions of a speedometer needle in relation to a speed scale dial.

In operation, termination 32 receives a positive voltage from power supply 90. Termination 30 also receives positive voltage from power supply 90, but only upon the closing of switches S1 and S2. Termination 28 becomes completed to ground 94 upon closing of switch S3. In the condition wherein switches S1, S2 and S3 are closed, piezoelectric transducer 14 emits a pulsating tone, the tone being produced by tone generator means 12 and the pulsations being produced by pulsator means 16.

In pulsator means 16, first and second NAND gates 36 and 38 cooperate with resistor 50 and capacitor 52

to cause the voltage at output 56 to alternately rise and fall in essentially a square wave manner at a repetition rate controlled by the values of resistor 50 and capacitor 52. The pulsator circuit is enabled only when inputs 42 and 47 are at a voltage near the supply voltage.

NAND gates 58 and 60 cooperate with piezoelectric transducer in an oscillatory manner so that transducer 14 is excited into vibration near its resonant frequency and sound is produced. Electrode 70 of transducer 14 provides a feedback voltage of a magnitude and phase to permit sustained oscillations in the circuit. When the voltage supplied from output 56 of NAND gate 38 to inputs 64 and 80 of NAND gates 58 and 60 is near the supply voltage, oscillation will occur in tone generator circuit 12. When voltage from output 56 is down or near ground potential the oscillations cease.

In the condition where switches S1, S2 and S3 are closed, pulsator means 16 is enabled by receiving a positive voltage at input 42 of NAND gate 36, (the input 47 of gate 38 is held at a positive voltage through resistors 26 and 103 so that the pulsator may be enabled by input 42) and a pulsating tone is emitted by piezoelectric transducer 14. In the condition where switch S6 or both switches S4 and S5 are closed, thereby connecting termination 34 to ground, pulsator means 16 is disabled through input 47 of NAND gate 38. This allows tone generator means 12 to run continuously thereby causing transducer 14 to emit a continuous tone.

What is claimed is:

1. An audible alarm system comprising in combination.
  - a. an input-output terminal means for providing electrical terminations for attaching electrical circuits;
  - b. a transient protection circuit for protecting said audible alarm system against voltage transients and having an input side connected to said input-output terminal means, and an output side;
  - c. a tone generator circuit for producing an audible tone and having an input side and an output side including a piezoelectric transducer connected to said input-output terminal means; and
  - d. a pulsator circuit for producing pulsations in said audible tone comprising:
    1. a first NAND gate section of a Quad two-input NAND gate integrated circuit package, a first input connected to said output side of said transient protection circuit, and a second input connected to one side of a first resistance means;
    2. a second NAND gate section of a Quad two-input NAND gate integrated circuit package, a first input connected to said output side of said transient protection circuit, a second input connected to an output of said first NAND gate section and to a first side of a second resistance means, and an output of said second NAND gate section connected to said input side of said tone generator circuit and to a first side of a capacitance means; and
    3. a second side of said first resistance means connected to a second side of said second resistance means and to a second side of said capacitance means
2. A multiple audible alarm system comprising in combination.
  - a. an input-output terminal means for providing electrical termination for attaching electrical circuits;
  - b. a transient protection circuit for protecting said audible alarm system against voltage transients and

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having an input side connected to said input-output terminal means, and an output side;

c. a tone generator circuit for producing an audible tone and having an input side and an output side including a piezoelectric transducer connected to said input-output terminal means; and

d. a ground isolation circuit providing more than one ground path to said multiple audible alarm system, a first side connected directly to said input-output terminal means, a second side connected directly to said input side of said transient protection circuit and to said input-output terminal means, and also to said input side of said transient protection circuit and to said input output terminal means through a first resistance means, and a third side connected to said input side of said tone generator circuit;

whereby said piezoelectric transducer provides pulsating sounds or continuous sounds in response to a precondition of said multiple function alarm system.

3. A multiple function alarm system according to claim 2 wherein said tone generator circuit further includes at least one NAND gate, said NAND gate and said pulsator circuit included as an integrated circuit package and wherein said third side of said ground isolation circuit is connected to a minus voltage terminal of said integrated circuit package and to said piezoelectric transducer.

4. A multiple function alarm system according to claim 3 wherein said pulsator circuit includes two NAND gates.

5. A multiple audible alarm system according to claim 2 wherein said input-output terminal means includes:

- a. a second termination connected to said third side of said ground isolation circuit;
- b. a second termination connected to said input side of said transient protection circuit and also through said first resistance means to said first termination;
- c. a third termination connected to said input side of said transient protection circuit; and
- d. a fourth termination connected to said of said transient protection circuit, said second side of said ground isolation circuit, and also through a second resistance means to said third termination.

6. A multiple audible alarm system according to claim 2 wherein said pulsator circuit comprises:

- a. a first NAND gate section of a Quad two-input NAND gate integrated circuit package, a first input connected to said output side of said transient protection circuit, and a second input to one side of a third resistance means;
- b. a second NAND gate section of a Quad two-input NAND gate integrated circuit package, a first input connected to said output side of said transient protection means, a second input connected to an output of said first NAND gate section and to a first side of a fourth resistance means, and an output of said second NAND gate section connected to said

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input side of said tone generator circuit and to a first side of a first capacitance means; and

c. a second side of said third resistance means connected to a second side of said fourth resistance means and to a second side of said first capacitance means.

7. A multiple audible alarm system according to claim 2 wherein:

said piezoelectric transducer has three electrodes, a first electrode of which is connected to said third side of said ground isolation circuit and said minus voltage terminal of a Quad two-input NAND gate integrated circuit package; and wherein said tone generator circuit further includes:

- a. a third NAND gate section of said Quad two-input NAND gate integrated circuit package, a first input connected to said output side of said pulsator circuit, a second input connected to a first side of a fifth resistance means and to a second electrode of said piezoelectric transducer, an output connected to a second side of said fifth resistance means and to a first side of a sixth resistance means;
- b. a fourth NAND gate section of said Quad two-input NAND gate integrated circuit package, a first input connected to said first input of said third NAND gate section, a second input connected to said second input of said third NAND gate section, and an output connected to said output of said third NAND gate section; and
- c. a second side of said sixth resistance means connected to a third electrode of said piezoelectric transducer.

8. A multiple alarm system according to claim 2 wherein said ground isolation circuit includes first and second diodes, the anodes of which are connected together and to said output side of said tone generator circuit and said minus voltage terminal, the same being a terminal of a Quad two-input NAND gate integrated circuit package, a cathode of said first diode connected to a first termination of said input-output terminal means and through a first resistance means to a second termination of said input-output terminal means, and a cathode of said second diode connected to said fourth termination of said input-output terminal means, through a second resistance means to a third termination of said input-output terminal means, and to said input side of said transient protection circuit.

9. A multiple audible alarm system according to claim 2 wherein said transient protection circuit comprises seventh, eighth and ninth resistance means, said seventh resistance means connected between said fourth termination and said input side of said pulsator circuit, said eighth resistance means connected between said third termination and a positive voltage terminal of a Quad two-input NAND gate integrated circuit package, and said ninth resistance means connected between said second termination and said input side of said pulsator circuit.

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UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

PATENT NO. : 3,922,672

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INVENTOR(S) : Birt, Sweany and Pirtle

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Col. 1 line 11, delete "he The"

Col. 1, line 21 delete the second occurrence "the"

Col. 1, line 21 delete the third occurrence "the" and substitute therefore ---The---

Col. 5, line 53 insert "connected" after input.

Signed and Sealed this

second Day of March 1976

[SEAL]

Attest:

RUTH C. MASON  
Attesting Officer

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Commissioner of Patents and Trademarks