

[54] **VEHICLE ALARM SYSTEM**
[75] Inventor: **Philip L. Nine**, Indianapolis, Ind.
[73] Assignee: **Curtis Dyna-Products Corporation**,
Westfield, Ind.
[22] Filed: **Apr. 14, 1971**
[21] Appl. No.: **134,033**

Related U.S. Application Data

[62] Division of Ser. No. 847,922, Aug. 6, 1969, Pat. No. 3,605,087.
[52] U.S. Cl. **307/235, 307/237, 307/10 AT, 307/10 R, 340/63, 307/247, 307/273**
[51] Int. Cl. **H03k 5/20, H02h 3/00**
[58] Field of Search **307/10 R, 10 AT, 307/10 LS, 237, 235, 247, 275; 340/274, 63, 64**

References Cited

UNITED STATES PATENTS

3,378,695 4/1968 Marette 307/237

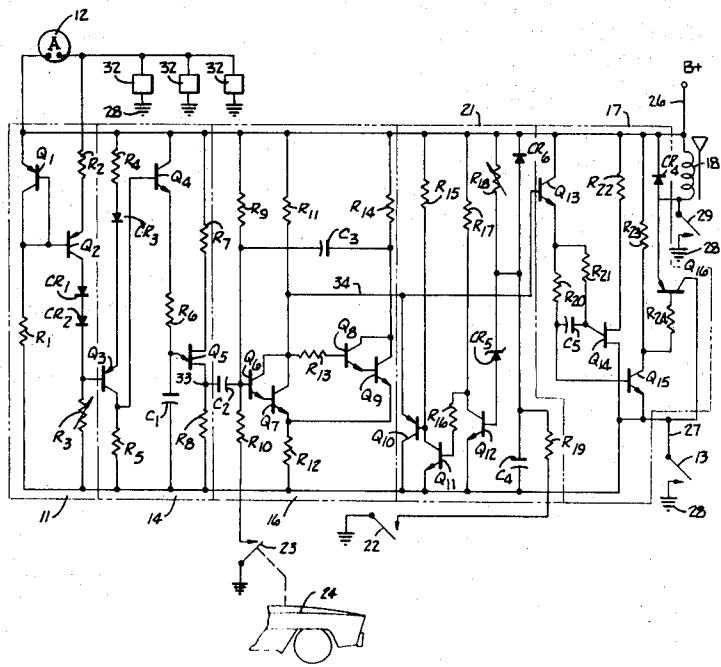
3,422,398 1/1969 Rubin 307/10 AT
3,531,793 9/1970 Shottenfeld 340/274 X

Primary Examiner—John S. Heyman
Attorney—Woodward, Weikart, Emhardt & Naughton

[57] **ABSTRACT**

A sensitive current detector includes the vehicle ammeter and is responsive to current therein to activate a first pulser which sets a monostable multivibrator which activates another pulser having an output to the vehicle horn relay to sound the horn at a 2 cycle per second (Hz) frequency. The monostable multivibrator resets after 1 minute of sounding of the horn to deactivate the horn unless the current detector continues to sense current. A delay timer responds to a key operated switch or a remote disable switch to inhibit, for 15 seconds, activation of the second pulser by the monostable. The monostable multivibrator can also be set by mechanically operable switches.

5 Claims, 2 Drawing Figures



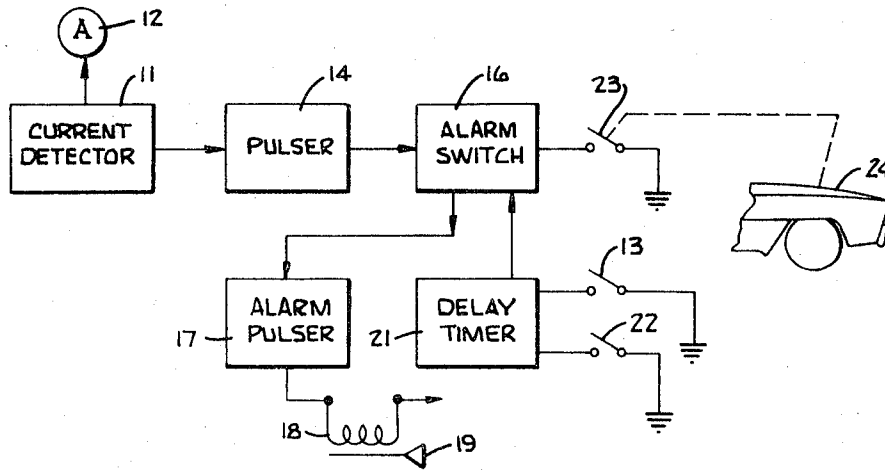


Fig. 1.

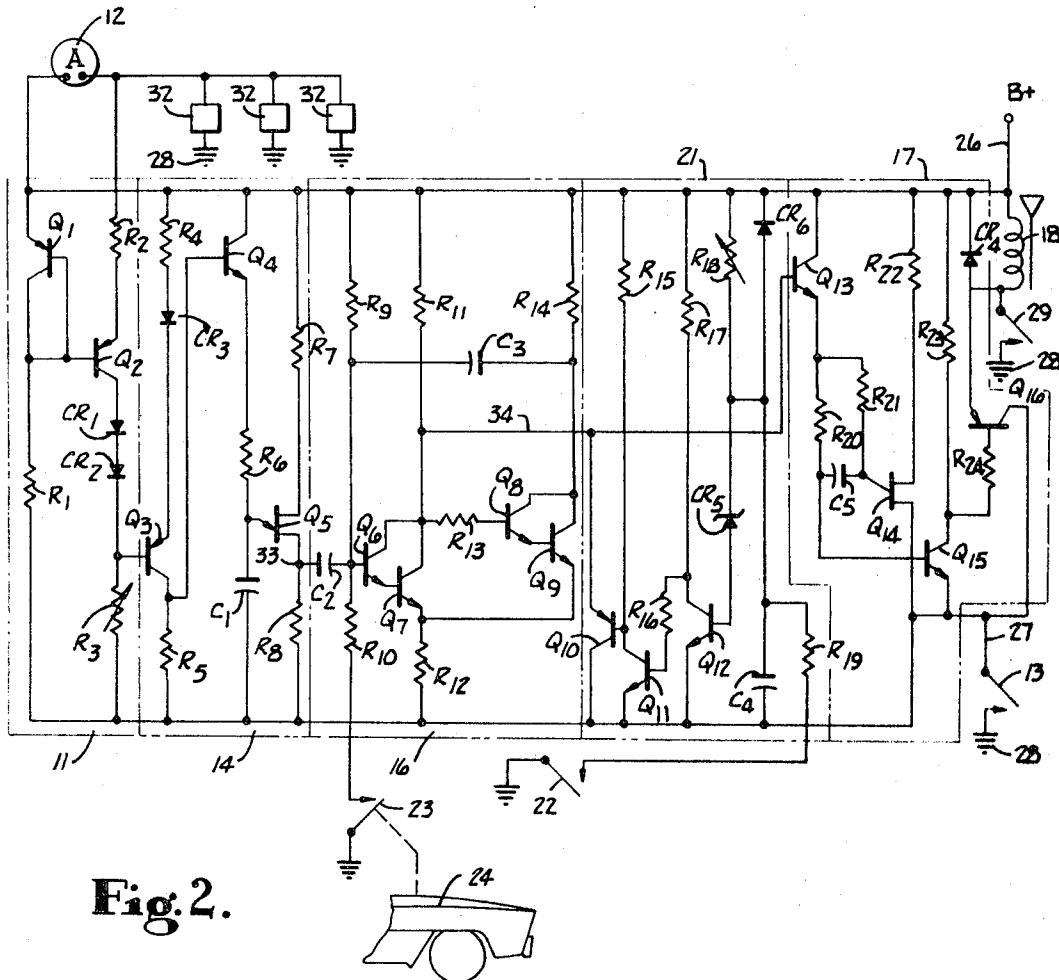


Fig. 2.

VEHICLE ALARM SYSTEM

This is a division of application, Ser. No. 847,922, filed Aug. 6, 1969.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates generally to alarm systems, and more particularly to a comparatively simple and inexpensive, but reliable system which is responsive, with high sensitivity, to electric current usage in a vehicle electrical system.

2. Description of the Prior Art

Alarm systems of considerable variety are known in the art. Yet there remains to be solved the specific problems created by new and different environments for alarms, new technology, and the ever present demand for lower cost and improved performance.

Vehicle alarm systems are known which respond to mechanical stimuli such as the opening of a window, or a door, or a hood. Another is known which uses an inductive coupling to a battery cable to initiate an alarm. Yet these devices have aspects which are considered disadvantageous in certain respects. It is an object of the present invention to provide a system meeting requirements as outlined above and providing a combination of features advantageous over systems currently known.

SUMMARY OF THE INVENTION

Described briefly, in a typical embodiment of the present invention, solid state circuitry is employed throughout and includes a two-transistor constant current source whose output is varied in response to small current usage in the vehicle electrical system, as by the illumination of a courtesy lamp upon opening a door, for example. The change in output is effective, after a predetermined initial delay, to set a multivibrator to initiate an alarm pulser, the pulser remaining activated to pulse the vehicle horn during the period of the monostable multivibrator prior to automatic reset thereof. A key switch is employed through appropriate time delay means to activate and deactivate the alarm system. A remote disabling switch and associated delay circuitry facilitates short term disablement of the system when desired by the proprietor thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of a typical embodiment of the present invention.

FIG. 2 is a schematic diagram thereof.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, and particularly the block diagram of FIG. 1, the current detector 11 is coupled to the ammeter 12 of the vehicle and responsive to current therein, after the key lock operated switch 13 is closed, to activate the pulser 14 which, in turn, activates the alarm switch 16. The steady state output of the alarm switch, once set by the pulser 14, activates the alarm pulser 17 producing a pulse output to the vehicle horn relay coil 18, to pulse the vehicle horn 19.

A delay timer 21 connected to the alarm switch 16 is activated initially upon activation of the alarm system by closing the key switch 13 to permit closing of doors or trunk lids or other activity by the proprietor of the

system (owner of the car, for example) for a predetermined period of the order of 15 seconds, for example. The delay timer may also be activated by closure of a disable switch 22 at any time after the alarm system has been activated by the key switch. Such a disable switch can be a magnetically operated reed switch located at some secret location on the vehicle. This permits temporary (15 second) disablement of the system by the proprietor to permit his entry into the vehicle, for example. Such a reed switch could be operated by temporarily holding a magnet near the switch as, for example, adjacent a corner of the windshield. In either event, the delay timer disables the alarm switch 16 from activating the alarm pulser for a period of approximately 15 seconds.

A mechanical switch 23 is provided and connected to some vehicle component such as a hood 24, for example, operation of this switch being effective to activate the alarm switch 16.

Referring now particularly to FIG. 2, the B+ terminal of the vehicle battery is connected to the supply line 26, and return line 27 is connectable to battery ground 28 through the key-operated switch 13. A variety of suitable key-operated locks can be employed for manually opening or closing this switch. The horn relay 18 is shown with one side thereof connected to B+ and the other side thereof connected through the normally open manually operable horn ring switch 29, the other side of which is at ground 28. One side of the vehicle ammeter is connected to B+ through line 26, the other side being connectable to ground 28 through any one of a variety of vehicle equipment items designated generally as 32. These can be courtesy lights as indicated above, a radio, ignition primary circuit, or parking light, for example.

As indicated above, the alarm system is activated or "armed" by closing the key lock operated switch 13. Although there is an initial delay thereupon initiated, prior to the time when the horn can be sounded by the alarm system, that feature will be described hereinafter. For the present, the various blocks appearing in the block diagram and described generally above, will now be described in more detail.

The current sensing circuit 11 includes a two transistor constant current source with the automobile ammeter 12 or suitable current shunt as a part of the current determining elements. The base-emitter voltage of the diode-connected transistor Q_1 , (V_{BE1}) is determined by the current thru Q_1 . This voltage appears across the base-emitter junction of Q_2 and across the emitter resistor, R_2 , of Q_2 and the ammeter. The base-emitter voltage of Q_2 , (V_{BE2}) is determined by the current thru Q_2 . If the current thru Q_2 is less than the current thru Q_1 , then V_{BE2} will be less than V_{BE1} . This voltage difference is predictable and is about 60 millivolts (mv) per decade of current difference. The voltage across the emitter resistor and the ammeter is $V_{BE1} - V_{BE2}$ and the current thru Q_2 is $V_{BE1} - V_{BE2} / R_2 + R_A$ when R_A is the meter or shunt resistance.

When current flows thru the ammeter from the battery, (eg. a light is on), the voltage drop across the ammeter will increase. The current, I , will decrease since $I = V_{BE1} - V_{BE2} - I_{Bat} R_A / R_2 + R_A$. The decrease of current, I , will cause a corresponding decrease in voltage at the collector of Q_2 , and will forward bias switching transistor Q_3 .

Resistor R_3 is a variable resistor for adjustment purposes, and resistor R_2 may be on the order of 1 ohm for appropriate sensitivity. Diodes CR_1 and CR_2 are employed for temperature compensation for the switching transistor Q_3 .

Transistor Q_3 is normally off when there is no current flow through the ammeter 12. It will turn on when the battery current increases to about 100 milliamperes (ma). When transistor Q_3 is turned on, it turns on the gating transistor Q_4 which begins charging capacitor C_1 through resistor R_6 . The unijunction transistor Q_5 will be fired when capacitor C_1 is charged, and will thereupon produce a pulse output at 33. Therefore, in this combination we have an astable multivibrator in the form of a unijunction sawtooth generator. The frequency is about 0.5 pulses per second. The charging time of capacitor C_1 is established at approximately 2 seconds in order that it be long enough to permit electric winding of the vehicle clock without firing the unijunction transistor.

The monostable multivibrator 16 includes transistors Q_6 and Q_7 and transistors Q_8 and Q_9 . The timing thereof is determined by capacitor C_3 and resistor R_9 so that when the multivibrator is set, it will remain in the set condition for approximately 1 minute and it is during this 1 minute period that the alarm is sounding, as will soon be described. Then it will automatically reset.

In its first normal stable state, the multivibrator 16 has transistors Q_6 and Q_7 conducting. However, upon application of a pulse through capacitor C_2 from the pulser 14 to the base of transistor Q_6 to set the multivibrator, the base of Q_6 is driven below ground, turning off these transistors and producing a positive going output signal at 34. In addition to the vehicle ammeter current responsive pulser means of setting the monostable multivibrator, it can be set by closure of the normally open mechanically operated switch 23, grounding the base of transistor Q_6 and turning off this one and thereby transistor Q_7 to produce the signal output at 34. Closure of the switch 23 could be effected by the opening of the vehicle hood, a door, a window, the luggage compartment, or some other mechanical activity.

When the multivibrator output signal appears on the output line 34, unless it is inhibited from activating the alarm by means of the circuitry 21, it is applied to the base of gating transistor Q_{13} to fire the second unijunction astable multivibrator Q_{14} which produces a 2 Hz pulse to the base of transistor Q_{15} which, through resistor R_{24} connected to the base of power transistor Q_{16} , drives the latter. The power transistor Q_{16} grounds the one side of the vehicle horn relay to sound the horn. The frequency of the astable multivibrator using the unijunction Q_{14} establishes the frequency at which the horn is sounded, giving the "beeping" or pulsating sound. This astable multivibrator will run until the monostable multivibrator 16 automatically resets itself, the timing of which is determined by the resistor R_9 and capacitor C_3 . The 2 Hz frequency of the alarm pulses is determined by capacitor C_5 , and resistors R_{20} and R_{21} .

It was mentioned above that the monostable multivibrator will automatically reset in approximately 1 minute, thus terminating the "beeping" of the vehicle horn. However, if current continues to flow in the vehicle ammeter, it will continue to be sensed by the sensor of the present invention, thus causing the pulser 14 to continue to supply the sharp pulses to the base of tran-

sistor Q_6 . Consequently the monostable will be triggered again each time it resets, so long as battery current continues to flow through the ammeter 12. Similarly, so long as the mechanical switch 23 remains closed, the monostable multivibrator will not reset or, if it does reset, will immediately be restarted and thereby continue to produce the needed output to the gating transistor Q_{13} to keep the alarm pulser running.

If the key lock operated switch 13 is located inside the vehicle, it is desirable to provide a certain period of delay between the time it is closed to arm the alarm system, and the time the system becomes armed. For this purpose, the initial delay circuitry 21 is provided. Transistor Q_{10} is connected between the monostable multi output 34 and ground. When transistor Q_{11} is "on" it will hold Q_{10} in saturation, thus inhibiting operation of the alarm pulser by the monostable multi 16.

Q_{11} is biased "on" when transistor Q_{12} is "off" and will turn "off" when Q_{12} turns "on." When the key switch is turned on, (i.e., closed) Q_{11} is turned on and Q_{12} is off. Capacitor C_4 starts charging thru resistor R_{18} . As soon as Zener diode CR_5 is forward biased (about 6V), Q_{12} turns "on," turning "off" Q_{11} and thereby Q_{10} and the monostable multivibrator 16 will no longer be inhibited from operating the alarm pulser.

Where the key operated switch is located inside the vehicle, it is desirable to provide some means for the operator to disarm the alarm system while he gains access to the interior of the vehicle to open the key switch. One example of means useful for this purpose is the provision of a magnetic reed-operated switch near one of the windows, such as the windshield for example. This switch can be operated by holding a magnet near it and such a switch can be employed as the "remote disable switch" 22 of the circuitry. Closure of this switch momentarily will discharge capacitor C_4 whereupon the threshold required by the Zener diode CR_5 for keeping transistor Q_{12} "on" will be removed. Thus transistor Q_{12} will turn off and transistors Q_{11} and thereby Q_{10} will again be turned on, and inhibit operation of the alarm pulser gate Q_{13} by the monostable multivibrator 16.

When the remote disable switch reopens after its momentary closure, capacitor C_4 will again start charging and, when the threshold of the Zener diode is reached, transistor Q_{12} will turn on to remove the inhibiting of the monostable multivibrator operation. In either event of utilization of the circuitry 21, the inhibit time is about 15 seconds. In normal usage, after the operator of the vehicle disables the alarm system with the remote disable switch, and enters the vehicle, he will utilize the key switch to disable the system. Diode CR_5 permits capacitor C_4 to discharge immediately when the key switch is turned off to disarm the system.

From the foregoing description, it will be recognized that the present invention has a variety of beneficial features. These include sensing electric current drawn from the battery to sound the alarm, turn-on delay, automatic reset, remote disabling, a pulsating alarm, mechanical switch activation as desired, and alarm delay. The sensor can be adjusted to be immune to steady state currents through the ammeter up to a certain level, if desired, and respond to any currents exceeding that level.

The invention claimed is:

1. A sensing method for an alarm system and comprising the steps of:

5

applying a potential to a diode-connected transistor to provide a first current therein establishing a desired base-emitter voltage therein,

applying the base-emitter voltage of said diode-connected transistor across a series combination of the base-emitter junction of a second transistor, an impedance, and a portion of a vehicle electrical system, thereby normally maintaining a forward bias on said second transistor to keep it normally conducting,

and applying a potential across the combination of said series combination in series with a second impedance,

and thereby establishing at said second impedance a voltage dependent on the current in said series combination as influenced and varied by change of resistance of said portion of said vehicle electrical system.

2. In an alarm system for a vehicle electrical system, a sensor comprising:

a constant current source having a normally conducting diode-connected biasing transistor with the emitter-collector path thereof in series with a first impedance means across an energy supply, and a normally conducting current source transistor having its base coupled to the collector of said biasing transistor and normally forward biased by the emitter-base voltage of said biasing transistor, and having its emitter-collector path coupled in series with

6

a second impedance means and a portion of said vehicle electrical system in a circuit with said energy supply,

the said current source transistor having an output conductor coupled thereto to produce an output signal thereon.

3. The alarm system of claim 2 wherein: said vehicle electrical system portion is one in common circuit relationship with a plurality of electrical devices of the vehicle electrical system.

4. The alarm system of claim 3 wherein: said sensor includes in the series coupling of the emitter-collector path of said current source transistor and said second impedance means and said electrical system portion in said circuit, third impedance means to establish the level of said sensor signal output in response to current flowing in said electrical system portion.

5. The alarm system of claim 4 wherein: said electrical system portion is resistance of an ammeter in series with said energy supply and the load of at least one of said electrical devices, said resistance rising upon flow of current from said energy supply through said load to reduce current in the emitter collector path of said current source transistor to thereupon change the level of said sensor signal output.

* * * * *

30

35

40

45

50

55

60

65