

AN ALARM FOR TOXIC GASES

Detects oxygen-hungry gases such as carbon monoxide and methane. . . . sounds a warning before dangerous concentrations are reached

BY CASS LEWART

WHEN a lethal fire starts, flame and smoke are not the only killers. Colorless, odorless carbon monoxide gas (CO) has been known to kill or incapacitate people—often far from the fire itself. One factor that makes CO such a stealthy, insidious assassin is its ability to elude conventional smoke detectors. These devices are similarly insensitive to dangerous hydrocarbon gases like methane (CH₄), a toxic compound that is the chief component of natural gas.

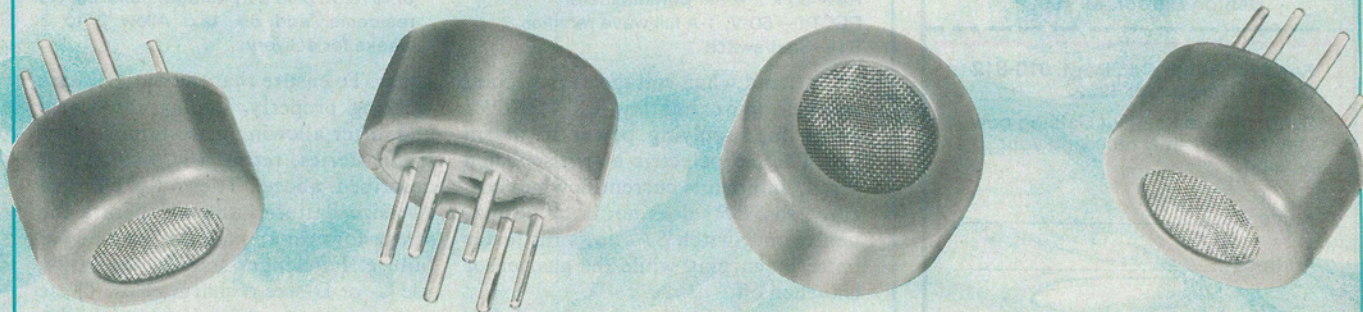
The Gas Alarm described here has been designed to sound its warning *before* dangerous levels of poisonous gases accumulate. The Gas Alarm should be considered complementary to, and not a replacement for conventional smoke detectors, as it will *not*

respond to ionized gases generated by fire unless the fire is smoldering in an enclosed area lacking oxygen. This project has the advantage of being self-powered, thus providing portable protection both at home and in hotels or motels when you travel.

The alarm is based on an inexpensive semiconductor sensor whose electrical resistance changes when its active surface is exposed to gases such as carbon monoxide, methane, butane, and alcohol vapors that have a strong affinity for oxygen. (These are known as *reducing gases*.) The sensor element is enclosed in a small capsule and protected by a stainless steel mesh, while a low-power heater activates the sensor element and purifies it after exposure to gas.

Circuit Operation. As shown in Fig. 1, transformer *T1*, fullwave rectifier *RECT1*, resistor *R2*, and filter capacitor *C1* make up the line-powered power supply for 5-volt regulator *IC1*. Resistor *R1*, in conjunction with rectifier *D1*, maintains the charge on the rechargeable cells in *B1*, while diode *D2* allows *B1* to power the circuit in stand-by mode when the line power is interrupted. Under these conditions, *D1* is reverse biased and battery power flows through forward-biased diode *D2* to power the circuit. The regulated output from *IC1* maintains a fixed heater voltage for gas sensor *TGS1* to provide uniform sensitivity. The combination of *R3* and *LED1* forms a power-on indicator.

When gas is present at *TGS1*, the



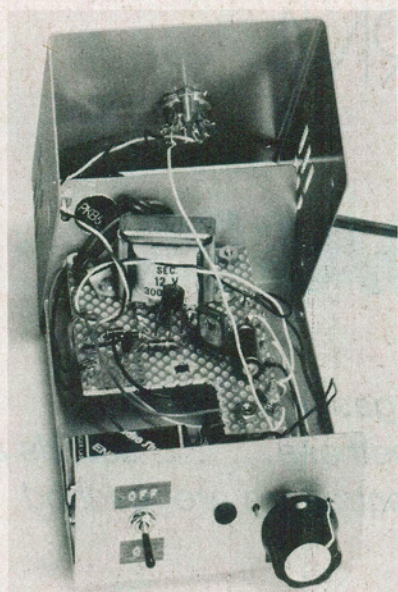


Photo of the author's prototype.

resistance of its sensor element drops, raising the voltage applied across calibration potentiometer *R4*. The rotor of *R4* is connected to the gate of

on perf board or multi-lug terminal strips using point-to-point wiring. Mount the socket for sensor on top of the cabinet for maximum exposure to surrounding air, and mount the alarm on the side or back of the cabinet for best audio output. The six rechargeable cells forming *B1* can be mounted in readily available battery holders.

Adjustment. (1) Plug the Gas Alarm into a 117-volt ac outlet; (2) rotate *CAL* control *R4* fully CCW for minimum resistance between the SCR gate and ground; (3) apply power and allow the sensor to stabilize for 1-2 minutes, then rotate the *CAL* control clockwise till the alarm sounds; (4) rotate *CAL* control CCW till the alarm stops. The alarm is now ready for operation. Test the system by rubbing a drop of alcohol between your fingers, near the sensor. When the alarm sounds, repeat steps two through four.

The rechargeable batteries are trickle charged when the alarm is plugged into an ac outlet, and will be fully charged after approximately 24

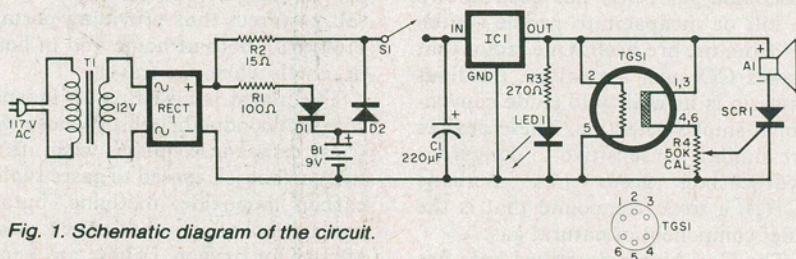


Fig. 1. Schematic diagram of the circuit.

PARTS LIST

A1—Piezoelectric buzzer (Radio Shack 273-060 or similar)
 B1—Battery (six rechargeable 1.5-V cells)
 C1—220- μ F, 16-V electrolytic
 D1, D2—200-V, 1-A silicon diode
 IC1—5-V regulator (Radio Shack 276-1770 or similar)
 LED1—Red LED (optional)
 R1—100- Ω , 1/2-W resistor
 R2—15- Ω 1-W resistor
 R3—270- Ω , 1/2-W resistor (optional)
 R4—50-k Ω linear potentiometer
 RECT1—50-V, 1-A full-wave rectifier
 S1—Spst switch

SCR1—200-V, 6-A SCR (Radio Shack 276-1067 or similar)
 TGS1—Gas sensor (See note)
 T1—12-V, 1-A transformer (Radio Shack 273-1505 or similar)
 Misc.—6" x 4" x 2 1/2" enclosure with cover, perf board or terminal strips, etc.
 Note—The following is available from C & R Electronics, Box 217, Holmdel, NJ 07733: Pretested gas sensor, with socket, \$10.95 plus \$1 postage/handling. NJ residents, add 5% tax. Allow 2 to 3 weeks for delivery.

SCR1, and when voltage at that point reaches approximately 0.3 V, *SCR1* turns on, supplying power to alarm *A1*. The piezoelectric alarm specified for *A1* interrupts current flow periodically, so *SCR1* does not latch permanently on. Switch *S1* allows for faster battery charging while the gas sensor is turned off.

Construction. The project will easily fit in a 6" x 4" x 2 1/2" metal cabinet, and all components except the alarm and gas sensor can be mounted

hours. To ensure that the batteries are working properly, unplug the alarm and, after allowing it to stabilize with the batteries, repeat the alcohol test described above. The fully charged AA-size batteries should operate the sensor for over an hour during a power failure. For longer standby operation use C- or D-size rechargeables. These will operate the alarm longer, but also require longer charging time. When the alarm is not in use, open *S1* to protect batteries from discharging through *IC1*. \diamond