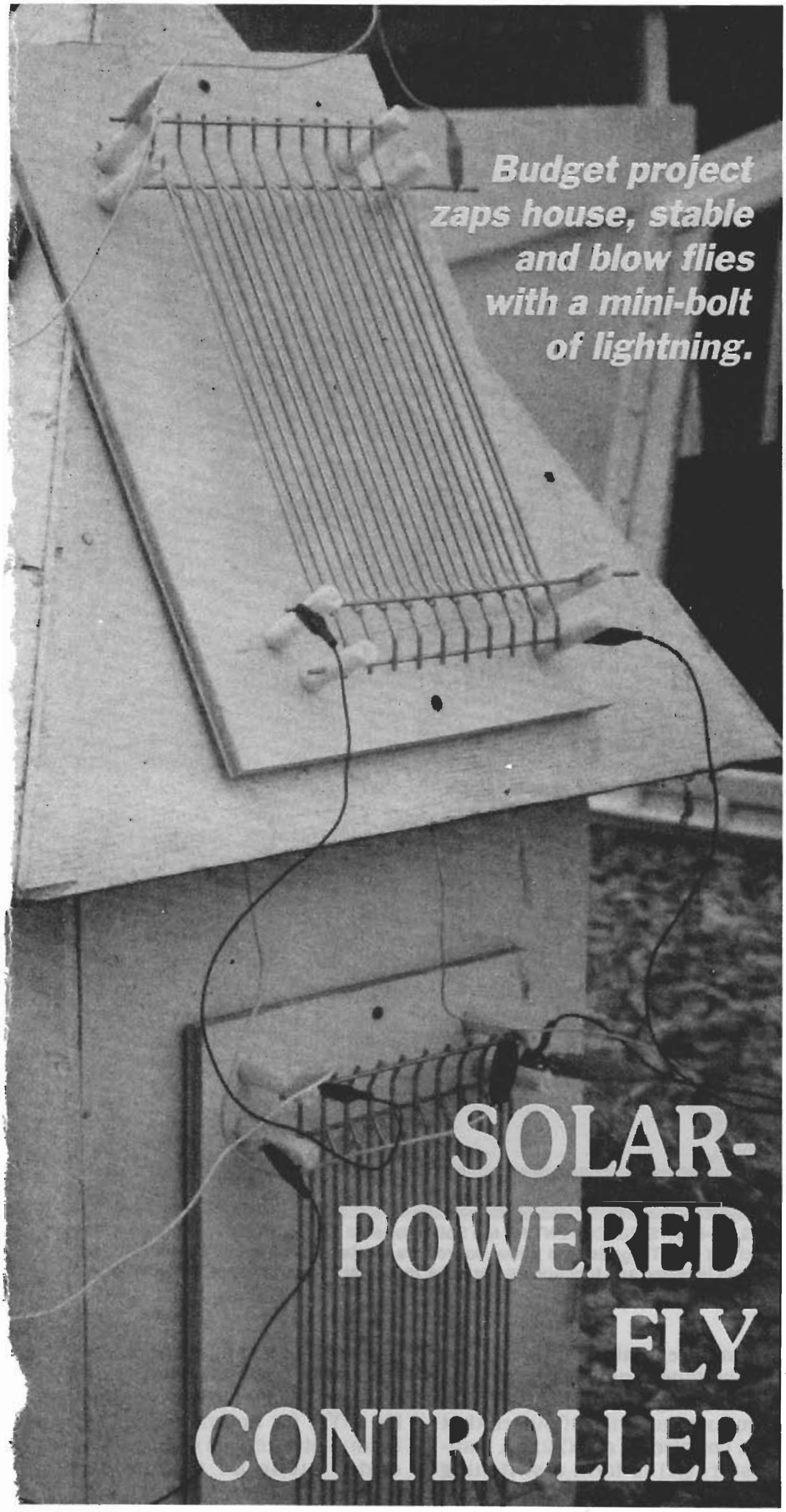

SOLAR-POWERED FLY CONTROLLER

Budget project zaps house, stable and blow flies with a mini-bolt of lightning.

LAWRENCE PICKENS

FLIES ARE A GREAT ANNOYANCE AND a health problem for man and beast. Flies breed in garbage cans, dumpsters, compost piles, and kennels, just to name a few sites. Most comon solutions to eliminate flies have their own problems. For example, chemical insecticide sprays can be applied to surfaces, and poisoned fly bait can be spread around the garbage cans, but both are environmentally unsafe, and they are not effective against every species of fly. Also, the poisons must be re-applied at regular intervals, compounding the pollution problem.

What is needed to keep the fly population down at breeding sites is a continuously working device that is environmentally safe; effective against house flies, stable flies and blow flies; and that requires limited maintenance. The Solar-Powered Fly Controller presented here is an effective fly-zapping device that you can build. It has a high-voltage electric grid that electrocutes flies that alight on it. Its advantage over commercial electric flying-insect traps is that it is driven by battery or solar power. Commercial units are powered by line current and are unsuited for use in backyards or other outdoor areas that are remote from power lines.

The controller's circuit is turned on or off either manually or automatically. A photoelectric cell automatically turns the controller off at night and during dense cloud cover that usually brings rain.

The controller remains in the off state until the ambient light is sufficient to cause the unit's phototransistor to restore power to the controller. The controller provides high-voltage pulses at one or two-second intervals in order to conserve battery life. The solar power feature provides power to drive the controller and keep the battery in an excellent charge state. The controller develops a peak-to-peak, high voltage of at least 3,000 volts that can jump across a 3-mm gap when a fly

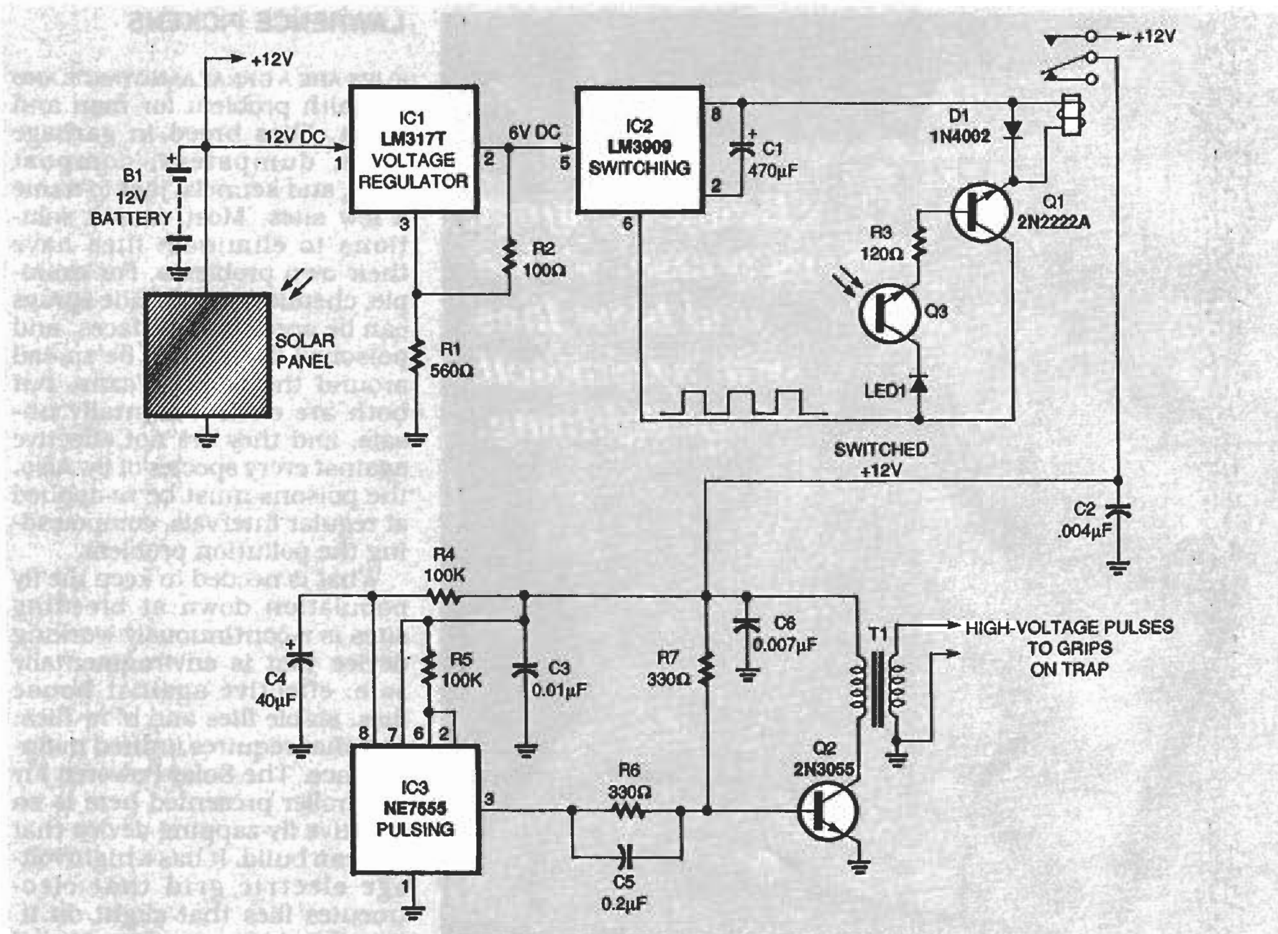

FIG. 1—SCHEMATIC DIAGRAM of the solar-powered fly controller is surprisingly simple.

alights in the gap. The high-voltage discharge current is below 8 mA which is considered safe for humans. Nevertheless, it is wise for humans to stay clear of the grid because an accidental shock may cause a person to involuntarily jump or slip into an obstacle and injure themselves.

The circuit

The circuit for the solar-powered fly controller is shown in Fig. 1. It consists of a switching circuit, pulsing circuit, and a high-voltage output circuit. The external power components are a 1- to 5-watt solar panel and a 12-volt motorcycle or camcorder battery. The output of the high-voltage ignition coil connects to a network of paralleled electrodes, called a grid, upon which flies land and are destroyed.

Voltage input to the LM3909 LED-flasher/oscillator (IC2) is kept at 6 to 9-volts by a LM317T voltage regulator (IC1). The exact voltage is not critical as long as it is regulated. The LM3909 produces a series of pulses that are coupled to a 2N2222A transistor (Q1) to form a switching circuit. An output of positive pulses from IC2 to the 2N2222A transistor boosts the pulse current so that it closes a 5-volt relay (RY1) for approximately 0.1 second at intervals of 1 to 2 seconds. Diode D1 shunts out

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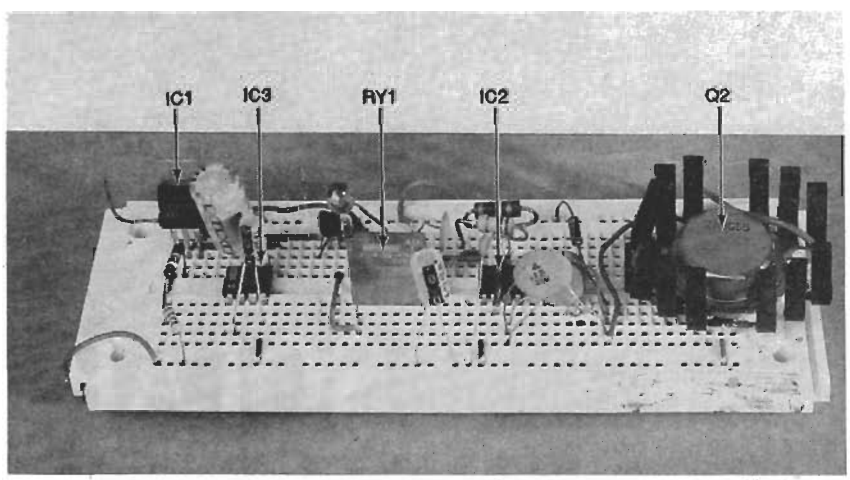

FIG. 2—PARTS PLACEMENT for the Solar-Powered Fly Controller is not critical. The ignition coil, T1, grids, and power source are located off the circuit board. Once the circuit is tested and functioning normally, move part by part to a matching PC board and solder in place.

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PARTS LIST

All resistors are 1/4-watt, 5% units.
R1—560 ohms
R2—100 ohms
R3—120 ohms
R4, R5—100,000 ohms
R6, R7—330 ohms

Capacitors
C1—470 µF, 25 volts, electrolytic
C2—0.004 µF, 25 volts, electrolytic
C3—0.01 µF
C4—40 µF, 25 volts, electrolytic
C5—0.2 µF
C6—0.007 µF, 100 volts

Semiconductors
D1—1N4002 diode
IC1—LM317T voltage regulator
IC2—LM3909 LED flasher
IC3—NE7555 or NE555 timer
LED1—Red LED
Q1—2N2222A switching transistor, NPN
Q2—2N3055 power amplifier, NPN
Q3—KTN2222 infrared phototransistor, NPN (Radio Shack 276-145 or equiv.)

Additional Parts And Materials
B1—12-volt deep-cycle battery
RY1—5-volt relay, single-pole, double-throw (Radio Shack 275-240 or equiv.)
1—12 volt type "T" or "CD" automobile ignition coil
1—13.8-volt, 1-watt photo-voltaic panel
1—6-inch modular solderless breadboard (Radio Shack 276-174 or equiv.)
1—6-inch modular PC board (matches solderless breadboard, Radio Shack 276-170 or equiv.)
Weather-tight automobile battery storage case, TO-3 heat sink, conductive-foil tape, wire, glossy-white boards or plastic panels, lumber for trap construction

Sources of some materials
Automobile ignition coil obtainable from J. C. Whitney Co., 2233 S Throop St., Chicago, IL, 60608 or most automotive parts store.
Solar panels obtainable from Edmund Scientific Co., 101 Gloster Pike, Barrington, NJ 08007-1380; from H & R Co., 18 Canal St., P.O. Box 122, Bristol, PA 19007-0122; and Integral Energy Systems, 109 Argail Way, Nevada City, CA 95959.

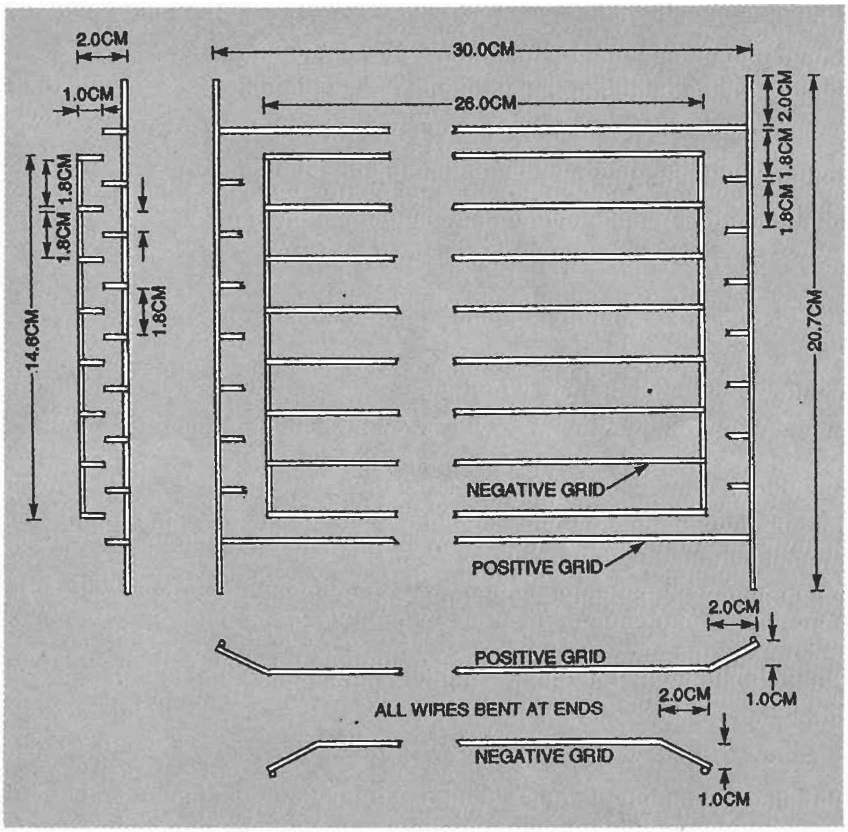

FIG. 3—THE GRID for the solar-powered fly controller is fabricated from stiff wire that can be assembled with solder, braising material, or by welding. No. 12 solid copper wire without insulation is a good choice. It forms easily and solders well with a 100-watt iron. (Note: 2.54 cm equals 1.0 inch.)

high-voltage spikes produced by the switching voltage across the relay's coil. The switching circuit is turned off at night or during periods of heavy cloud cover by phototransistor Q3 whose internal resistance increases as the ambient light diminishes. This reduces the positive bias on Q1's base, causing the transistor to cut off. LED1 serves as a voltage dropping device.

Single-pole, single-throw relay RY1 provides brief pulses of the 12-volt battery voltage to IC3, an NE755 timer that is wired as a free-running audio-frequency pulse generator. The pulses are amplified by a 2N3055 power amplifier transistor, Q2. The output of Q2 drives an automobile ignition coil, T1, to generate the high-voltage pulses for the external grid. The output voltage at the secondary winding of T1 is approximately 12,000-volts peak-to-peak.

The circuit is powered by a 12-volt rechargeable lead-acid or nickel-cadmium battery. A 1-watt or better solar panel of the type used to keep automobile batteries charged should be used to eliminate the need to recharge the battery frequently. Many different solar panels are available on the surplus market where the price is considerablly less than buying new for catalog suppliers.

Building the controller

The parts for the controller first are assembled on a solderless breadboard with the 12-volt battery, solar panel and ignition coil off the board. Install C6 as close to the T1 primary winding as possible. Power the unit up and be sure the circuit is functioning. Check for a spark at the center terminal of the ignition coil.

Remove the parts one at a time and mount them on a matching PC board. Figure 2 shows the author's layout on a solderless board. Put the wired

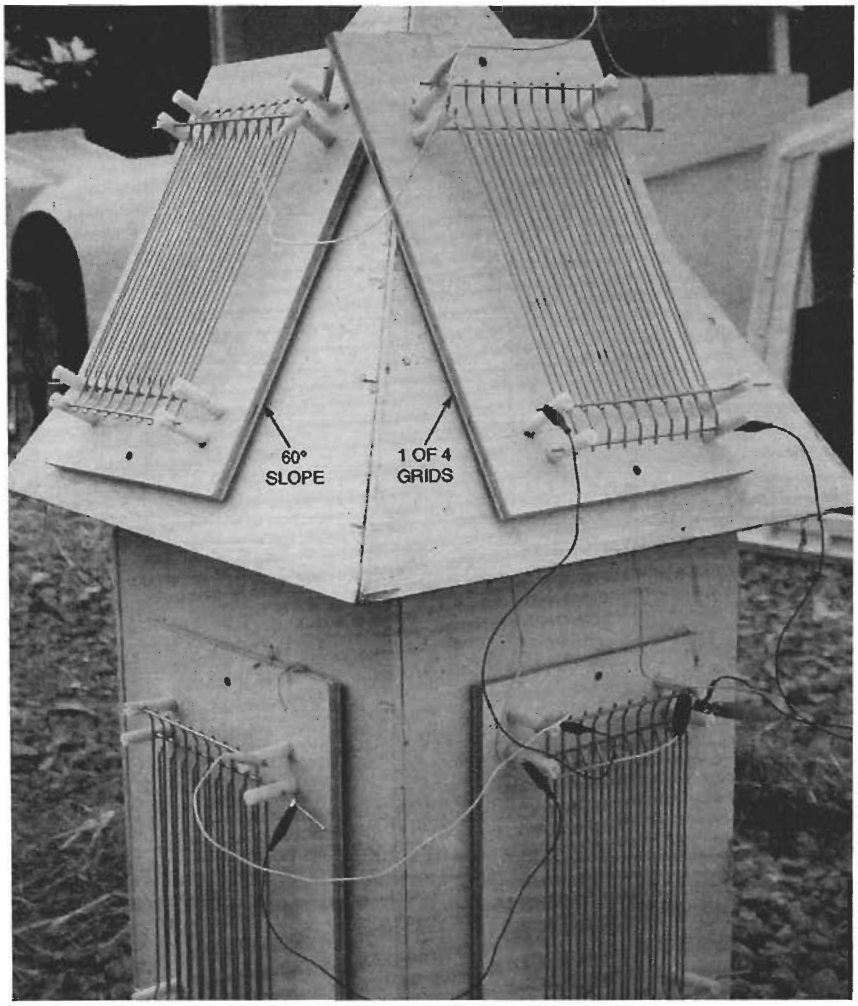

FIG. 4—THE GRIDS ARE MOUNTED on a box form, called a trap, (each controller can support up to four grids), that houses the controller and rechargeable battery. The solar cells may be mounted on a short mast and sloped to catch the maximum sunshine available.

FIG. 5—VIRTUALLY ANY automobile ignition coil can be used for T1.

PC board aside until it is needed.

The high-voltage grid

The grid is made up of two comb-like elements (Fig. 3) which are spaced 5 mm apart from edge to edge. (Note: 25.4 mm equals 1.0 inch.) The grid elements can be constructed from 16 gauge wire (i.e. a coat hanger), from conductive foil, or from a combination of foil and wire. A good alternative is #12 bare, solid, copper wire used by electricians to wire houses.

The grid should be mounted on high-gloss white wooden or plastic panels and the panels should be mounted either vertically or with a sixty degree slope from the horizontal (see Fig. 4). Porcelain standoffs electrically isolate the grid from the panels that could become conductive when wet. The terminal for the case of the transformer T1 (if it has one) is grounded to earth as is the negative input of the primary and secondary windings. One terminal of the grid is connected to the same common ground. The high voltage line from the secondary winding is attached to the other grid terminal. One controller circuit can easily power four grids.

Operation of the trap

To eliminate flies, place four grids on a specially constructed stand as shown in Fig. 4. This configuration is called a trap. The slope of the grids mounted at the top of the trap is sixty degrees from the horizontal. The grids are mounted on adjacent surfaces of the trap. Place one trap to the north, and one to the east of places where flies gather. Good spots are at the eastern ends of buildings which house animals, near dog kennels, and near garbage cans or dumpsters. For best results, check the traps once a day and remove any insects or debris which have become lodged in the grids and are shorting the grid.

Safety concerns

Although the current available at the controller's grids is very small, the voltage is high enough to jolt a person. Therefore, power to the controller should always be turned off before handling any part of the circuit or grids. Also, the device should not be used where children can reach it. A high-voltage warning sign will keep curious adults away.

The solar-powered fly controller shown in the photographs has been in use for five years to control flies around kennels, garbage cans and in animal pastures. Several controller circuits and traps have been assembled and put to use at indoor and outdoor locations. None had any down time because of malfunction. If sufficient sunlight and an adequately sized solar panel are present, the batteries will remain charged for the life of the trap. Ω