CIRCUIT CIRCUS

By Charles D. Rakes

Electronic critter ridders

IMAGINE, THAT BIG THREE-DAY weekend has finally arrived, and you've labored long and hard to get things in tip-top shape for the events to come. The debris that has cluttered the backyard for all too long has been neatly packaged (the night before) and set out for pick-up by the sanitation department. Ah...all is right with the world (or so you thought). The morning before the big event (trash collection day), you open the front door to find that all of your efforts were for naught.

Neighborhood strays have chosen the sidewalk in front of your house as their restaurant, and made your neatly stacked refuse the main course. It's not that you mind their having wrangled a meal from your discards, but did they have to make such a mess?

This month, the Circus deals with a number of electronic "critter-ridder" circuits designed to electronically eradicate just about any uninvited diners. Now don't get the wrong idea, because I dearly love our animal friends, and wouldn't build a circuit to harm or mistreat a single one. But there are some places and times that man's best pal should be restricted from a given area.

For instance, if Mama's flower garden is in constant attack by your favorite pooch and you are getting all of the flack for Rover's tunneling, don't lose control and set steel traps or fire off a scatter gun. Instead, draw your soldering iron and build one of our circuits to "humanely" guide Rover out of Mama's hair, and restore peace and tranquility to your home.

Doggies aren't the only critters that these circuits are designed to move out; actually, just about any living creature with ears won't stay around for long in an area where one of the eradicator circuits is operating.

Audible Critter Chaser

Figure 1 shows the schematic diagram of the *Audible Critter Chaser*. The circuit is designed to flood an area with a continuous high-frequency tone to frighten away four-legged intruders. At the heart of the circuit is a 741 op-amp (U1) that's configured as a variable-pulsewidth, high-frequency audio oscillator. Potentiometer R8 (25K) sets the frequency of oscillation, while R9 (50K) sets the pulsewidth of the output signal that's used to drive transistor Q1.

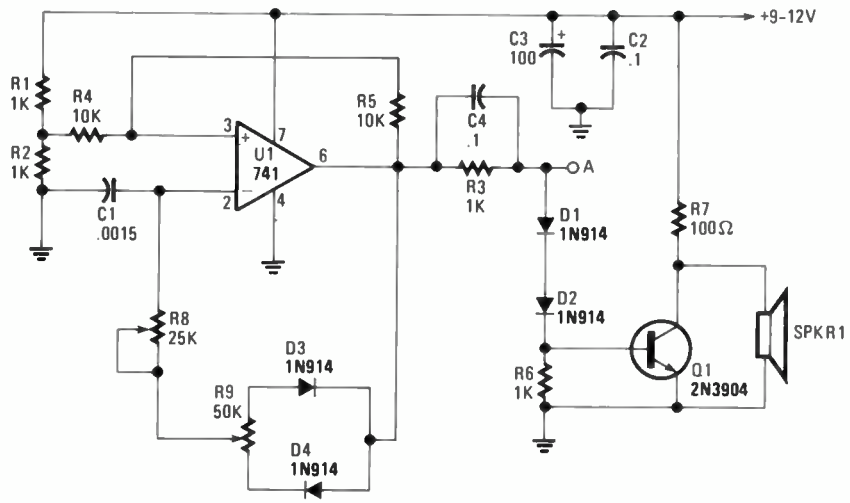

Fig. 1—The Audible Critter Chaser is designed to flood an area with a continuous high-frequency tone to frighten away four-legged intruders.

PARTS LIST FOR THE AUDIBLE CRITTER CHASER

U1—741 general-purpose op-amp, integrated circuit
Q1—2N3904 (2N2222 or similar) general-purpose NPN transistor
D1–D4—1N914 small-signal, silicon diode
C1—0.0015-μF, 100-WVDC mylar capacitor
C2, C4—0.1-μF, 100-WVDC mylar capacitor
C3—100-μF, 16-WVDC electrolytic capacitor
R1–R3, R6—1000-ohm, ¼-watt 5% resistor
R4, R5—10,000-ohm, ¼-watt 5% resistor
R7—100-ohm, ¼-watt 5% resistor
R8—25,000-ohm, potentiometer
R9—50,000-ohm, potentiometer
SPKR1—Piezo tweeter speaker
Perfboard material, enclosure, IC socket, 9 to 12-volt power source, wire, solder, hardware, etc.

Because the negative output swing of the 741 doesn't go completely to ground, D1 and D2 offer just the right amount of offset to allow Q1 to turn off during the negative portion of the oscillator's output signal. Resistor R3 sets the maximum drive current delivered to the base of Q1. Capacitor C4 functions as a speed-up capacitor to couple the high-frequency content of the drive pulse to the base of Q1, forcing it to turn on quickly. That keeps the efficiency high and Q1 cool.

The narrow output pulse, developed at the collector of Q1, is direct coupled to a high-output piezo tweeter, SPKR1. The output circuit is designed to drive an 8-ohm piezo speaker only. So don't blow the circuit by using a standard speaker with a voice coil.

There is nothing critical about the circuit, so it can be built on perfboard or a printed-circuit board. In either case, the use of an IC socket for U1 is recommended. A compact unit can be built by mounting the circuit and speaker in a plastic or metal enclosure, and obtain-

ing power from a wall plug-in 9- to 12-volt DC power supply.

When testing the Audible Critter Chaser, aim the piezo speaker away from the work area, or temporarily connect a 1000-ohm resistor in series with the speaker and the output. Set R8 to about mid position and turn R9 so that its wiper is at the cathode end of D4. That R9 setting produces the narrowest output pulse and the most-irritating sound with a minimum of current drain on the power source. Power up the circuit and play around with R8 and R9 to obtain the most-obnoxious sound that you can generate.

If you only want to irritate four-legged critters, then try reducing the value of C1 to one-half the value given in the Parts List, or try an even smaller value, and see how Rover responds to the near ultrasonic sound. The oscillator can be pushed beyond our own hearing range, while still producing enough output to drive most high-frequency sensitive critters away. Warning: Do not force an animal to stay in an area where the circuit is in operation! And always leave a clear and defined exit for their early departure. The animal may become frightened and confused, and in that state they can become very dangerous (even to their masters).

Control Oscillator

If a continuous irritating tone isn't enough, then add the low-frequency *Control Oscillator* circuit in Fig. 2 to the circuit in Fig. 1 to create a pulsating, mind-blocking, headache-producing chaser circuit that should remove even the most stubborn of intruders.

In the schematic diagram of Fig. 2, U2 (a 555 oscillator/timer) is configured as a low-frequency oscillator, with the off/on time (or duty cycle) equal to about one second each. The output of U2 at pin 3 is used to turn Q2 on and off at the rate of oscillation. The collector of Q2 can be connected to point "A" in Fig. 1 to turn the audio output of the circuit on and off.

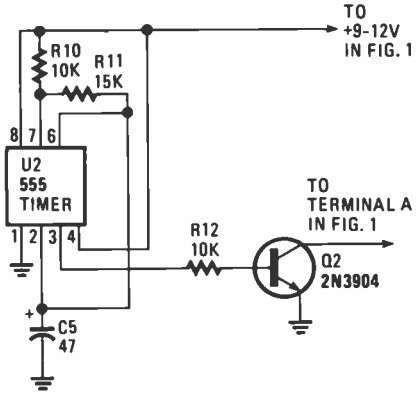

Fig. 2—The heart of the Control Oscillator is a 555 timer that's configured as a low-frequency oscillator whose output at pin 3 is used to turn Q1 on.

PARTS LIST FOR THE CONTROL OSCILLATOR

U2—555 oscillator/timer integrated circuit
Q2—2N3904 (2N2222 or similar) general-purpose NPN transistor
C5—47-µF, 16-WVDC electrolytic capacitor
R10, R12—10,000-ohm, ¼-watt 5% resistor
R11—15,000-ohm, ¼-watt 5% resistor
Perfboard material, enclosure, IC socket, wire, solder, hardware, etc.

The Control Oscillator's operation is simple. When Q2 (of Fig. 2) is tied to point A of the Chaser circuit (in Fig. 1), the Chaser circuit oscillates as designed, feeding its output signal to SPKR1 as long as Q2 (Fig. 2) is turned off. But when the output of the 555 swings positive, Q2 (Fig. 2) turns on and pulls the base Q1 (Fig. 1) low. That low turns off the output of the speaker. When the output of the 555 swings negative, Q2 (Fig. 2) turns off, allowing the output of the oscillator in Fig. 1 to be passed to the speaker.

To change the 555's frequency, experiment with the values of R10, R11, and C5. To lower the rate of oscillation, increase the values of those components; and to increase the rate, decrease their values. The duty cycle of the circuit can be varied by changing the values of R10 and R11.

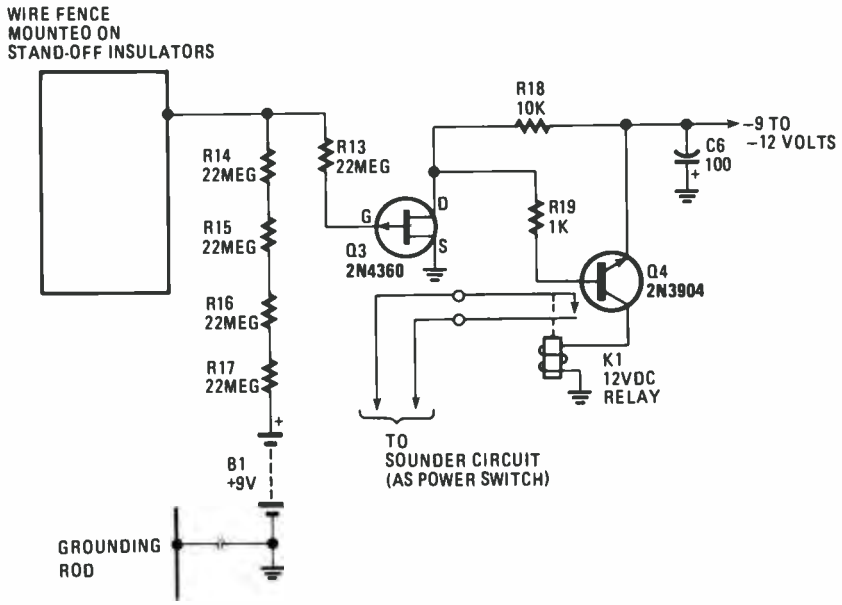

Fig. 3—The Automatic Switch uses a wire fence as a sensor, and a 12-volt relay to control the on/off operation of the Audible Critter Chaser.

Automatic Switch

Wouldn't it be great if the sounder circuit could be turned on automatically just when it is needed to drive out an intruder and not have it running all of the time? Wouldn't it also be nice if the sounder circuit could be used to protect a specified object or area outside? Fear not, because the circuit in Fig. 3, in conjunction with a fence, does just that.

The fence, which is used as a sensor, might be a bare wire around a small garden, shrub or special tree, or even the garbage barrel is connected to the input of the Automatic Switch. The relay (K1) contacts can be connected to the Audible Critter Chaser to turn on the sounder each time an intruder is detected.

As shown, five 22-megohm resistors are connected in series with a 9-volt bias battery, ground, and the gate of Q3 (a 2N4360 JFET). The fence sensor connects to the circuit at the junction of R13 and R14. The positive battery voltage fed through the five resistors keeps Q3 biased off.

As long as the fence wire is insulated from ground, transistor Q3 remains turned off, but when something touches the fence while in contact with the Earth (i.e., whenever something is grounding the fence), the bias is drained off through the intruder. That turns on transistor Q3, causing current to be drawn through R18. With the current flowing through R18, a base bias is supplied to transistor Q4, turning it on, which in turn causes the relay contacts to close, supplying power to the Audible Critter Chaser circuit.

The on time of the sensor circuit can be extended somewhat by connecting a 47-μF electrolytic capacitor across R18; the cap should be hooked up with the positive lead connected to the drain of Q3. That's a good area to experiment in to tailor the circuit to suit a specific need.

When installing the fence wire, be sure to use a good insulator at each tie point, and a ground rod to insure a good Earth ground system. If you happen to be close to a powerful radio station, a small capacitor might be needed between the gate of Q3 and ground. Stick with very small capacitors, say 5 to 39 picofarads. If the capacitor is made too large, the RC time constant will be too long for Q3 to respond to a fast moving intruder.

PARTS LIST FOR THE AUTOMATIC SWITCH

Q3—2N4360, P-channel JFET
Q4—2N3904 (2N2222 or similar) general-purpose NPN transistor
K1—500- to 1000-ohm, 12-volt DC relay
C6—100-μF, electrolytic capacitor
R13-R17—22-megohm, ¼-watt 5% resistor
R18—10,000-ohm, ¼-watt 5% resistor
R19—1000-ohm, ¼-watt 5% resistor
B1—9-volt transistor-radio battery
Perfboard material, enclosure, grounding rod, wire, solder, hardware, etc.

There are several other sensors that can be used to detect an intruder and turn on the Audible Critter Chaser circuit. An ultrasonic or IR motion detector can be used to activate the Chaser, or a mirror and IR light rope could be placed around a garden to trigger the sounder.

Pest Zapper

The circuit shown in Fig. 4—the *Pest Zapper*—is offered as a last resort to help get rid of the most stubborn of intruders. The heart of the circuit is a Model "T" coil, which can be found at auto salvage yards. (A Model "T" coil is an automobile ignition coil that differs slightly from those used in modern cars. Similar coils can be manufactured by placing a buzzer in series with the primary of the coil, and placing a capacitor across the buzzer to reduce any arcing.)

To conserve battery power, the "T" coil is turned on and off by a low-frequency UJT oscillator. Maximum battery drain occurs only when the SCR turns the coil on for a brief period of time. During the majority of the time, little current is taken from the power source.

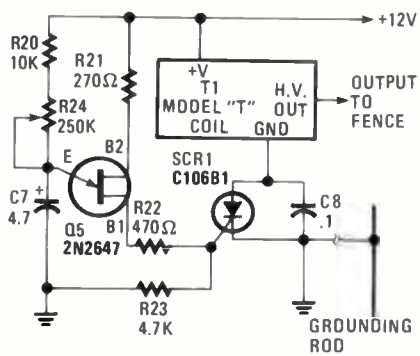

Fig. 4—The Pest Zapper is built around a model "T" coil. To conserve battery power, the coil is turned on and off by a UJT oscillator.

The operation of the Zapper is very simple. Components R20, R24, and C7 set the time interval for the UJT oscillator. The discharge path for the timing capacitor, C7, is through R22 and the gate-cathode junction of SCR1. The resistance of R22 sets the maximum gate current and also determines the SCR's on time. When experimenting with different values for R22 stay within the limits of 270 to 1000 ohms. The Pest Zapper can be used in conjunction with the Automatic Switch in Fig. 3 so that it turns on only as needed, or with the Control Oscillator for use in intermittent operation.

How about combining all four circuits, and adding a delay to the Pest Zapper, so that the circuit comes on only after prolonged contact with the sensor (fence), which would indicate that the Audible Critter Chaser has failed to accomplish its mission. There are all sort of possibilities. How many can you come up with?

Until next month go forth and rid a critter electronically. ■

PARTS LIST FOR THE PEST ZAPPER

Q5—2N2647 N-channel UJT
SCR1—C106B1 200-PIV, 3- to 6-A silicon-controlled rectifier (SCR)
C7—4.7-μF, 16-WVDC electrolytic capacitor
C8—0.1-μF, 100-WVDC mylar or ceramic disc capacitor
R20—10,000-ohm, ¼-watt 5% resistor
R21—270-ohm, ¼-watt 5% resistor
R22—470-ohm, ¼-watt 5% resistor
R23—4700-ohm, ¼-watt 5% resistor
R24—250,000-ohm, potentiometer
T1—Model "T" Ford spark coil
Perfboard material, enclosure, grounding rod, insulators, wire, solder, hardware, etc.