



## HOW-TO BOOKLET #3002

# CIRCUIT BREAKERS



### TOOL & MATERIAL CHECKLIST

- New Breakers/Correct Amp Size to Fit Breaker Box
- Standard Slot and Phillips Head Screwdrivers
- Electrician's Wire Cutters
- Wire Strippers
- Voltmeter

*Read This Entire How-To Booklet for Specific Tools and Materials Not Noted in the Basics Listed Above.*

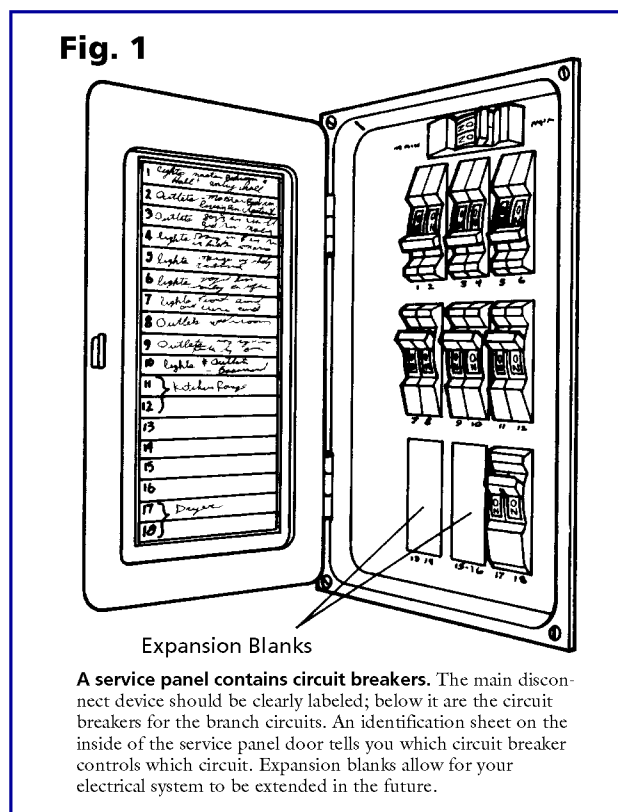
Circuit breakers might be called a renewable resource because to reactivate a tripped breaker you flip a toggle switch instead of replacing a fuse, which you probably don't have handy when one goes bad. Replacing a malfunctioning circuit breaker toggle – or installing a new one – is almost as easy as replacing a fuse in a regular fuse box.

A circuit breaker (**Fig. 1**) snaps open when there is a power overload or a short on the circuit. Until this problem is corrected, the circuit breaker will continue to click open.

### SHORT CIRCUITS AND OVERLOADED CIRCUITS

If a circuit breaker trips, you have either a short circuit or an overloaded circuit. To find the cause, disconnect all lamps and appliances on the affected circuit and then re-energize that circuit. If a circuit breaker trips with all appliances disconnected, you have a short circuit and the house wiring itself must be repaired or replaced. If the circuit is good, reconnect each lamp and appliance, one at a time. Extreme caution is required. Examine each lamp carefully and never plug in frayed or bare cords or damaged plugs.

The circuit breaker should trip when you plug in the faulty lamp or appliance. Check for a broken light socket or other problem and have repairs made before using the lamp or appliance again.



## OVERLOADED CIRCUITS

If one particular circuit is repeatedly interrupted, there may be too many appliances or lamps on that circuit. It may be necessary to add an additional circuit for appliances with heavier current drain.

## WHEN TO CALL FOR HELP

If your entire house is without power, call your utility or local electrical contractor. You may have a problem with the service panel or wiring leading to it. Outages of this magnitude are generally beyond the level of expertise of the do-it-yourselfer.

### KEEP SAFETY FIRST

Working with electricity is not hazardous as long as you obey strict safety rules. Always shut off or disconnect power before handling wires. If you are working on the electrical service entrance, do not stand on a damp floor. Protect yourself by wearing rubber gloves, and stand on a rubber mat or a piece of dry wood. Above all, if you are in any doubt about how to do any particular job, call in a licensed electrician.

## REACTIVATING BREAKERS

A tripped circuit breaker may have four different configurations, depending on the brand of circuit breaker installed in your home (Fig.2).

- 1 The toggle of the breaker will be in the center of the breaker. To reset the breaker, turn the toggle to its full OFF position. Wait several seconds. Then snap the toggle to the full ON position.
- 2 The toggle of the breaker will be in the center of the breaker and a red-colored flag will appear alongside of the toggle indicating a tripped position. To reset the breaker, flip the breaker to the full OFF position, wait a couple of seconds, and then flip the toggle to the full ON position. You may hear a couple of snaps as the toggle goes through the sequence.

Make sure that the toggle is over to the ON position even though the toggle may sound as if it has been reactivated.

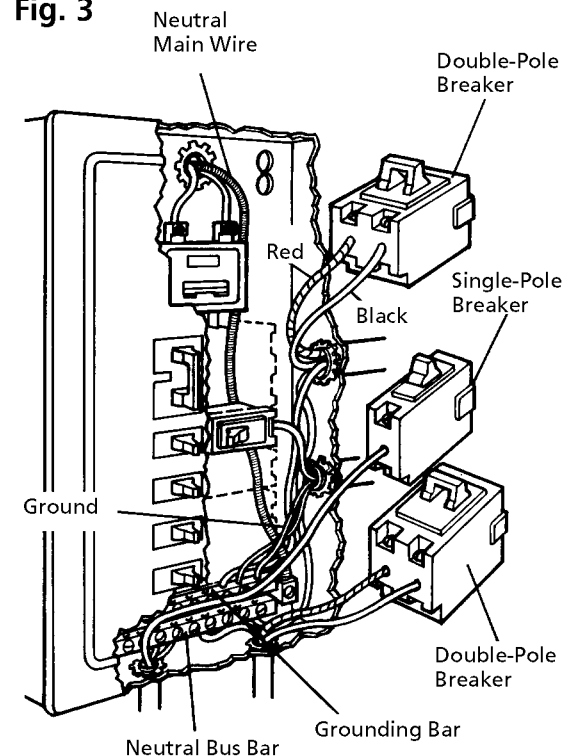
- 3 The toggle will be on the full OFF position – not halfway as detailed in items 1 and 2. Simply flip the toggle to the full ON position.
- 4 The toggle is in the OFF position. Push the toggle in and release the toggle to reset the circuit.

Sometimes in resetting tripped breakers, the individual breaker will become loose in the circuit breaker box. It wobbles and may need to be reset. What most likely has happened is that the breaker has become loose in its mounting inside the circuit breaker box (Fig. 3). To reset the breaker:

- 1 Turn OFF the power at the main power shutoff.
- 2 Remove the cover panel of the circuit breaker box. It is held with screws that turn counterclockwise.
- 3 With your fingers (there is no power so you are safe), push the loose breaker back into the slot in the breaker box. You may hear it snap, which indicates that it is properly seated.
- 4 Replace the cover panel and turn ON the main power shutoff.

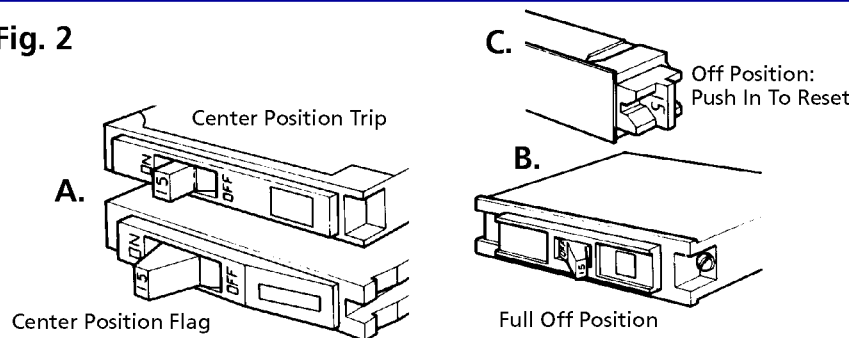
If the loose breaker does not seat properly, it may be damaged. If so, it must be replaced.

Fig. 3



How breakers fit into a circuit breaker box. The breakers are connected with wires, as shown, or simply snap into the service panel. Before working, turn off power.

Fig. 2



### Breakers trip and reset differently.

(A) Some model breakers trip to the center of the breaker; others trip to the center and show a red flag. Flip the toggle to the full OFF position, then flip it to ON. The 15 refers to the amperage. (B) The toggle action of some breakers also trips to an OFF position. Push to full OFF and then ON. (C) This toggle snaps to the center. Push in on the toggle to reset it properly.

## Replacing/Adding Circuit Breakers

Replacing a damaged circuit breaker or adding a new circuit breaker to a breaker box is not difficult. There are two basic breaker unit types: snap-in and wired.

Whenever you purchase breakers, whether for a new installation or as a replacement, first identify the manufacturer of the service panel and the amperage of the circuit. This information is required to get the right type of breaker for your panel. It's very important to remember that circuit breakers manufactured by various companies are not generally interchangeable, so make sure you purchase the right replacement. Do not replace with a higher ampere rated breaker.

**Replacing a Faulty Circuit Breaker.** To replace a bad standard circuit breaker proceed as follows:

- 1 Turn OFF the power at the main power shutoff. Stand on a dry board or rubber mat as you disconnect the power and work on the replacement breaker.
- 2 Remove the cover panel from the circuit breaker box. It is held with screws that turn counterclockwise. Once the panel is removed, check with a voltmeter to make sure the power is off. Be careful to avoid contact with the supply wires connected to the main power shutoff. They are still hot.
- 3 Next, switch the handle on the circuit breaker you're replacing to the OFF position.
- 4 Remove the damaged breaker. The breaker pulls out of its slot in the box. The breaker may be connected to the box with wires. Or, the breaker may be the type that does not have wires; it simply snaps into the box opening and, at the same time, automatically links with the power wires.

- 5 Loosen the screw terminals and remove the wires. A single-pole breaker will have one wire attached (usually black). A double-pole breaker will have two wires attached (usually black and red, or black and white). A tandem or "piggyback" breaker, will have twice as many wires attached, since it squeezes two circuits in the space of one.
- 6 Loosen the binding screw on the new breaker and move the handle to the OFF position.
- 7 Grip the new breaker as shown in (Fig. 4) and plug it firmly onto the mounting base and the bus bar.
- 8 Place the load wire in the terminal lug and tighten securely.
- 9 Replace the cover panel, switch the main power shutoff ON and the new breaker ON. Test the circuit with a voltmeter.

**Adding a New Circuit Breaker.** If you're adding a breaker for a new circuit:

- 1 Turn OFF the power at the main power shutoff.
- 2 Test to make sure that the power is off by touching the terminal screws of the main power cables with the probes of a voltmeter (Fig. 5). If the power is not off, call in a professional electrician to check the service panel.

- 3 Remove the knockout in the breaker box for the new breaker. In the side of the box, knock out the circle of metal matching the breaker location so the cable you are using may be connected properly.
- 4 Strip the cable insulation to allow enough wire for the connection to the neutral bus bar and the new circuit breaker. Connect the cable to the box with the proper fitting for this.
- 5 Run the ground wire and the white neutral wire of the cable to the neutral bus bar and connect them (Fig. 3).
- 6 Attach the red and/or black wire to the new circuit breaker, also shown. Double-pole breakers are connected with a red and black wire; single-pole breakers (in most installations) are connected with just the black wire. Then clip the breaker to one of the box's hot bus bars.
- 7 If the breaker is a double-pole unit, it will take up two spaces in the breaker box. It is for a 240-volt circuit. Both wires are considered power wires, and they are fastened to the breaker, as illustrated in Fig. 3. The ground wire only is connected to the neutral bus bar. Combination 120/240 breakers use the very same type of double-pole breakers. Here, the white wire is connected to the neutral bus bar.

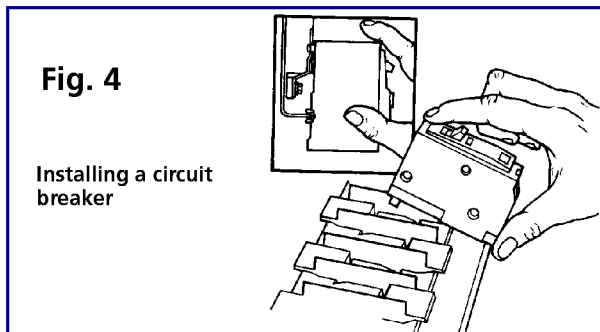


Fig. 4

Installing a circuit breaker

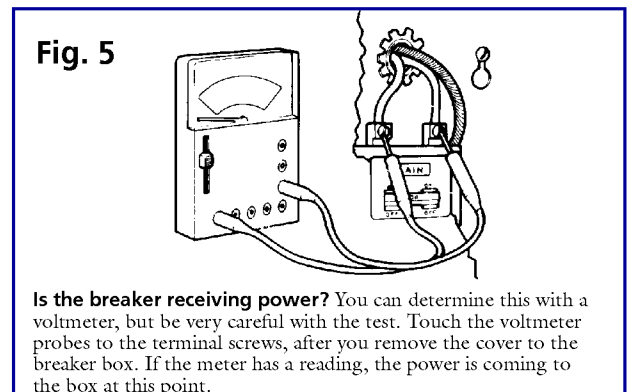


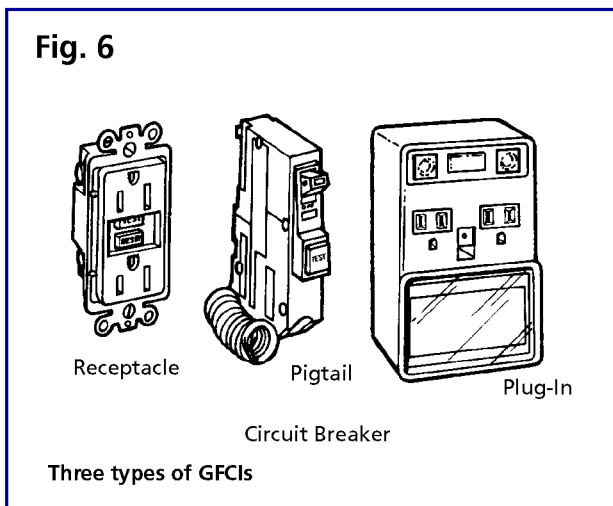
Fig. 5

**Is the breaker receiving power?** You can determine this with a voltmeter, but be very careful with the test. Touch the voltmeter probes to the terminal screws, after you remove the cover to the breaker box. If the meter has a reading, the power is coming to the box at this point.

## REPLACING/ADDING GFCI BREAKERS

If your home isn't equipped with ground fault circuit interrupter (GFCI) circuit breakers, their installation is well worth considering when you plan to upgrade electrical service. Not only do they provide the same safety overcurrent protection as a standard circuit breaker but they also protect against the hazardous effects of certain kinds of ground faults that can cause electric shock. By code, the GFCIs must be installed in new homes in a circuit in the areas where a ground fault is a possible hazard. Water, for example, is a potential hazard, as is a wet or damp floor. That is, GFCIs are found in kitchens, bathrooms, and perhaps, laundry and garage electrical circuits.

GFCIs compare the amount of current entering a fixture on the black wire with the amount leaving on the neutral wire. Any discrepancy indicates leaking in the system. If the GFCI detects a difference between the current, it breaks the current in 1/40 second, fast enough to prevent serious and sometimes fatal shock.



## The Three Types of GFCIs (Fig. 6)

- 1 Direct-wired GFCI receptacles can be installed in place of individual receptacles and offer the same ground fault protection as circuit breaker GFCIs. Follow the manufacturer's instructions for installation and testing carefully.
- 2 Circuit breaker/GFCIs offer the same overcurrent protection as standard circuit breakers, plus protection against the hazardous effects of ground faults.
- 3 Plug-in or portable GFCIs provide fault protection wherever it is needed. These devices are simply plugged into any 15 or 20 amp, 120 volt AC receptacle.

**Installation of GFCI Circuit Breaker.** To install a GFCI circuit breaker, proceed as follows:

- 1 Remove the old breaker. Use steps 1 to 5 outlined in "Replacing a Faulty Circuit Breaker."
- 2 Switch the GFCI breaker OFF and connect the white pigtail wire to a terminal on the neutral bus bar.
- 3 Plug the breaker in the mounting chassis.
- 4 Identify the white neutral wire on the circuit you're working with. Connect it to the breaker terminal marked "load neutral". Connect the black wire to the breaker terminal lug marked "load power".
- 5 Replace the panel cover, switch ON the main breaker, then switch ON the GFCI breaker.
- 6 With the GFCI ON, push the "push to test" button. If a handle moves to the trip position and the power to the circuit goes OFF, the GFCI is working properly.
- 7 To reset the GFCI, push the handle to the extreme OFF position, then turn ON. Then test the circuit with a voltage tester.

If a GFCI breaker trips, it could be caused by a short circuit or an overload circuit or due to a leakage path to ground. If it tripped while you were using a tool or appliance, that tool or appliance is most likely to be the trouble source. Unplug it, reset the GFCI and test the circuit. If the GFCI device remains ON, do not use the tool or appliance until it has been professionally repaired. If the GFCI does not remain ON, unplug all loads on the circuit one at a time, resetting the GFCI and testing the circuit each time. If you locate the trouble source this way, do not use the lamp, tool, or appliance until it has been professionally repaired. If you have not located the trouble, your wiring system may be leaking to ground or misconnected, and should be checked by a licensed electrician.

GFCIs should be tested every month or so. You can do this by pushing the bottom marked "test." The test button will activate or trip the reset button to show that the device is working. Then push the reset.

### NOTE:

**GFCI devices will trip immediately if the neutral wire of its load circuit touches or connects to ground or the neutral wire of another circuit.**