TECH TIP # 39

HARDI
HEATING, AIRCONDITIONING & REFRIGERATION DISTRIBUTORS INTERNATIONAL

One of a series of dealer contractor technical advisories prepared by HARDI wholesalers as a customer service.

Grounding Promotes Safety

The purpose of grounding is safety. The term "grounding" refers to parts of the wiring system or equipment such as motors, electric ranges, etc., that are connected to the earth. (Methods of achieving a "good" ground are clearly spelled out in electric codes.)

The neutral or white wire in an ordinary residential wiring system is the grounded wire in the system. The grounded, neutral wire is never interrupted by a fuse, circuit breaker or switch.

In addition to the grounded neutral (white) wire which grounds the electrical side, there is also a grounding wire which is usually green or green with a yellow strip. It may also be a bare, uninsulated wire. The green or bare grounding wire is used to ground equipment or non-current carrying metal parts of the electrical system --- junction boxes, conduit, armored cable, etc. How does this grounding promote safety?

First of all, it should be understood that a very small amount of current can kill. As little as 0.06 amps passing through the chest of an adult may cause a fatality. Also, current flows through every path available -- not just a single path of least resistance. Obviously, the amount of current through each path depends on the resistance of each path. Fuses and circuit breakers, on the other hand, react to relatively large surges in current. Consider the situation in Figure 1.

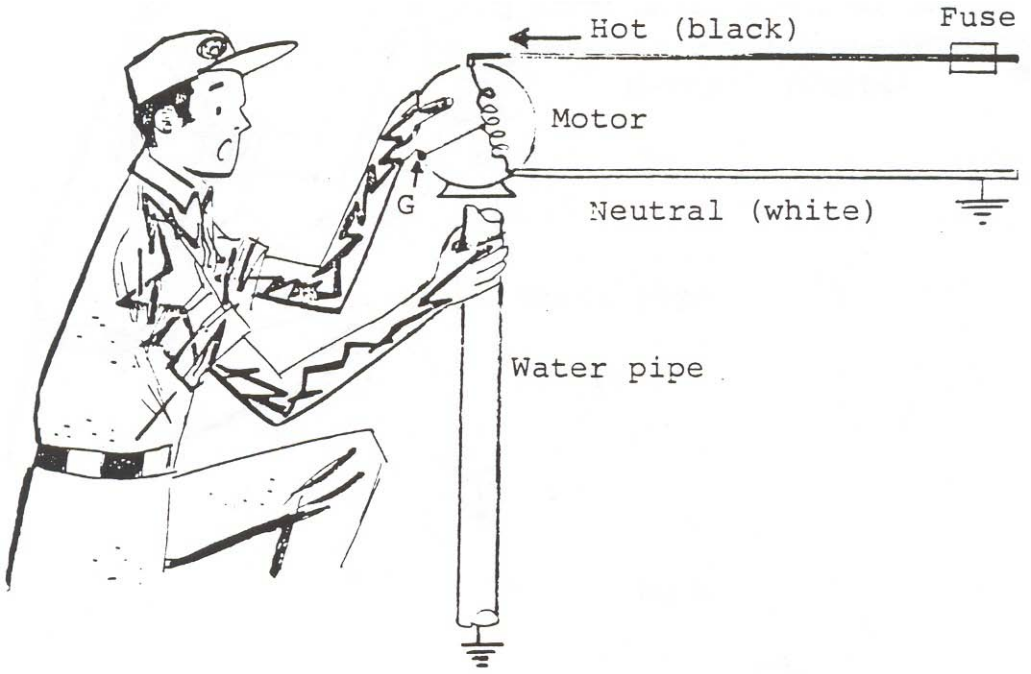

Figure 1

Here we have a fuse-protected branch circuit serving an electric motor. If an electrical connection "short" develops between the motor windings and the motor frame at say "G," the entire frame of the motor would become electrically "hot." When a service person touches the motor frame, and say, a water pipe, they provide a additional path for the current and a shock occurs. Even without touching the well-grounded water pipe, some degree of electrical shock would occur if they were standing on concrete in contact with the earth, touching metal around sinks, water or any other grounded surface. The quality of the ground would affect the severity of the shock as well as the voltage/current of the circuit. And since a person offers some resistance to current, it is very likely the fuse would not be affected since the added current drain would be tiny.

Let's take this same situation --- an electrically hot motor surface --- and now add a green grounding wire from the motor frame back to the electric service panel (Figure 2). In this case, the grounding wire carries most or even all of the stray current and may even cause the circuit fuse to blow (or trip the circuit breaker) because the grounding wire imposes little resistance compared to the person. Even if the fuse does not blow, a good grounding wire will reduce the voltage potential of the frame to essentially zero so there would be little or no "pressure" to move current.

When armored cable, metal conduit or nonmetallic sheathed cable with an integral bare, uninsulated grounding wire is used, this type of grounding protection is automatically provided --- assuming code requirements for full system grounding are followed.

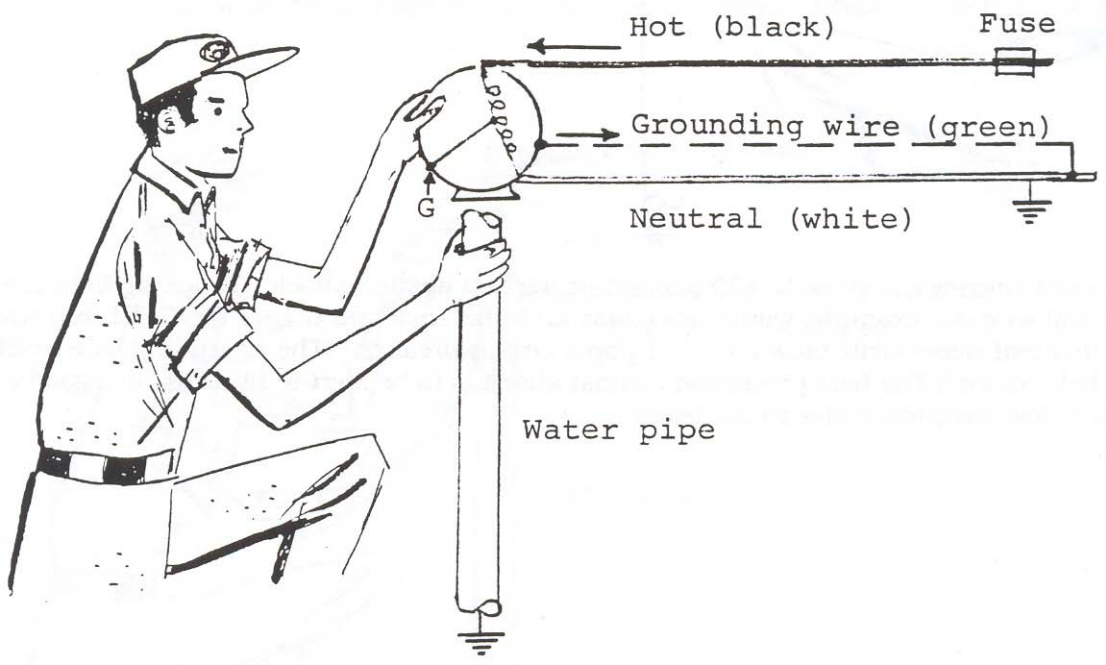

Figure 2

In addition to grounding the metal parts of an electrical system as well as the connected equipment, modern electrical code requirements provide that a Ground Fault Circuit Interrupter (GFCI) be used on particularly hazardous circuits --- such as in bathrooms, garages and outdoors.

A GFCI operates by sensing the current flow in both the hot (black) line and the neutral (white) line. When both are in balance --- current in black and white equal --- the GFCI does not stop the current flow. In Figure 3 we see the GFCI consists of a coil. When an imbalance occurs because of a ground fault, an electromotive force is induced in the coil and this triggers a switch to shut off the current in the circuit. Approved GFCI's must respond to a circuit imbalance of but 0.006 amps --- as illustrated --- in 0.025 seconds. By interrupting the circuit quickly, the person touching the hot motor frame is protected from serious shock.

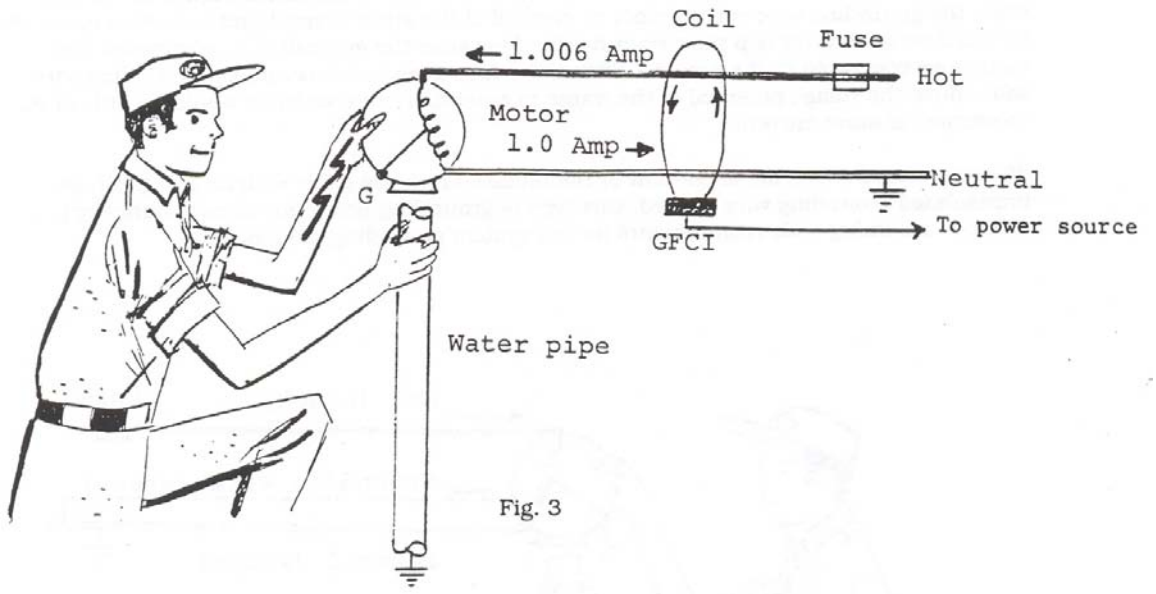

Fig. 3

No safety device can provide 100 percent protection against shock. Touching both the hot and neutral wire, for example, would not cause an imbalance and trigger the GFCI, nor would such an incident necessarily blow a fuse or pop a circuit breaker. (The grounding wire would be of no help as well.) The best protection against shock is to be alert to hazards, use good judgment and equipment, and follow electrical codes to the letter.

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