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Preventing Electric Shocks by Proper Grounding

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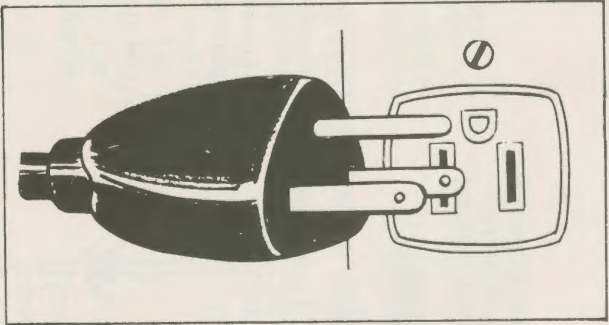
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PREVENTING ELECTRIC shocks

By Proper Grounding



COOPERATIVE EXTENSION SERVICE
SOUTH DAKOTA STATE UNIVERSITY
U. S. DEPARTMENT OF AGRICULTURE

Preventing Electric Shocks

By William H. Peterson, Extension Agricultural Engineer

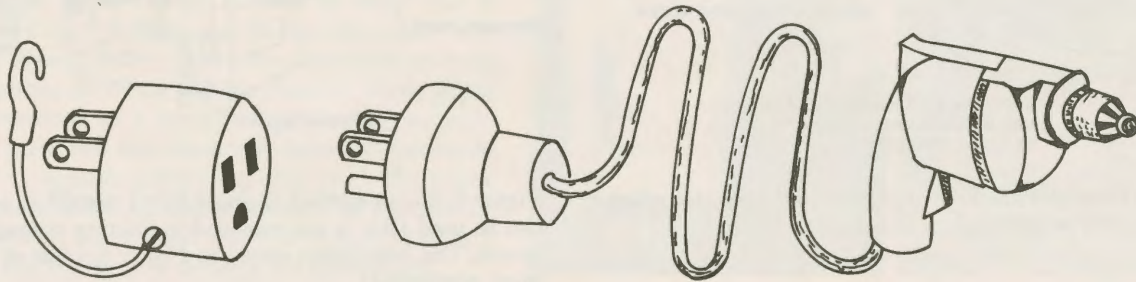


Figure 1. An electric drill, equipped with a three-prong grounding type plug, is shown with an adapter for use in a two-prong receptacle (left). The appliance is not grounded

until the adapter wire is properly connected to a ground. Otherwise, the operator in effect is installing himself as the conducting path which any stray current will take to ground.

SHOCKS KILL

The amount of electric current required to light a $7\frac{1}{2}$ -watt Christmas tree light bulb is sufficient to kill a human being. In fact more persons are killed by 115-volt shocks than by high-line current.

Ordinary fuses will not protect against the lethal wallop packed in the common 115-volt "house line," but proper grounding can. Safety is the reason manufacturers are supplying three-prong grounding type plugs with many portable tools and other appliances (as seen with the drill in Figure 1).

WHAT GROUNDING DOES

Should an appliance become energized through a breakdown of the insulation or because of dampness, the fault current will be carried away from the appliance frame by the "third-wire"—the ground. If there is no other channel, current will be carried to the ground through the body, producing a hazardous shock if the person is touching anything that is grounded. The third prong of a three-prong plug is connected by a green insulated wire inside the cord to the frame of the appliance.

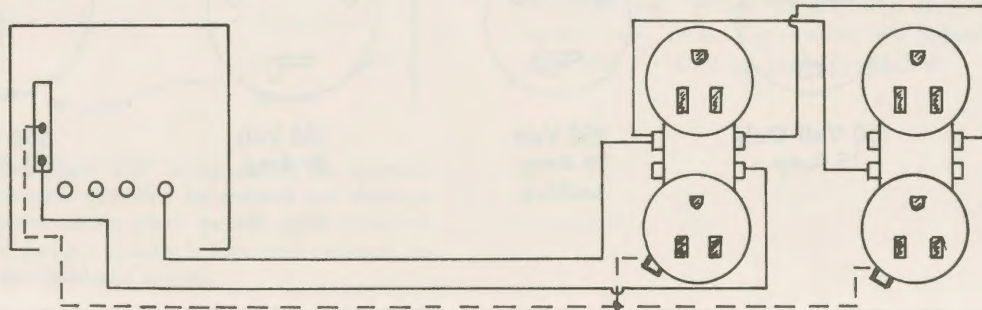


Figure 2. Internal wiring (dotted line) from receptacle to main entrance fusebox (on left) connects the green-colored grounding terminal of the receptacle to the grounded service

entrance neutral and carries off potentially harmful stray currents. The metal wall receptacle box (not shown) is also grounded.

METALLIC PATHS THAT SAVE LIVES

Internal wiring connections for properly grounding a three-prong receptacle are shown in Figure 2. The rectangle on the left represents the main service entrance "fusebox." Solid lines represent the wires that normally carry current to the receptacle. The dotted line represents the "third wire" that connects electrically to the third prong on the three-prong plug. The other end of the "third wire" is connected to the grounded neutral at the service entrance box, providing a good metallic path for any stray current to go to ground.

If this metallic path is not provided, any person coming in contact with the appliance becomes the

metal's substitute—a conductor for stray current. The grounding screw terminals of receptacles and plugs are a hexagon shape and green for identification. These grounding type receptacles are required by the electric code in all locations in new home construction and farm wiring.

Existing two-prong receptacles can be converted to three-prong grounding receptacles if a third grounding wire is run from the main fusebox to the receptacle box.

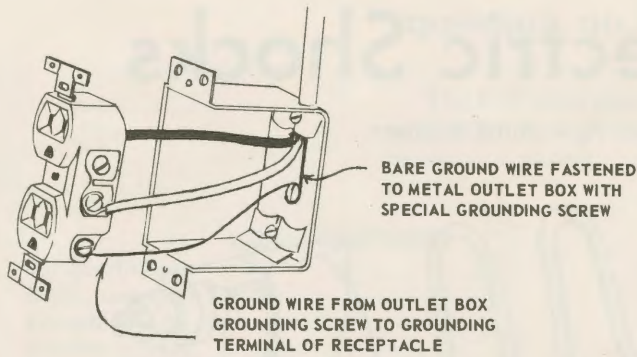


Figure 3. Illustrates method of connecting bare grounding wire from cable to terminal on receptacle.

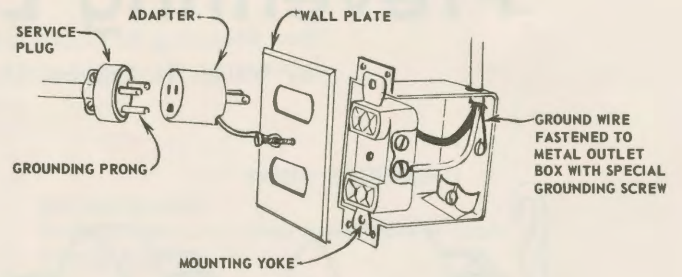


Figure 4. Shows method of grounding a metal box so adapter can be used (this is not provided in existing wiring in most homes. The installation shown in Figure 3 is just as easy and more permanent).

HOW TO USE THE ADAPTER

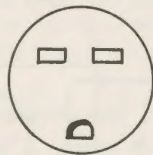
Many business and public buildings in South Dakota already have grounded receptacle boxes, since wiring was by metal conduit (pipe). However, most homes and farm buildings in South Dakota are not wired in conduit and boxes are not grounded. Figure 4 shows a wall box, wired in cable, in which a bare, "third wire" serves as ground to the box. The wiring in installation, shown in Figure 3, is just as easy to install and more permanent.

The three-prong adapter permits use of an appliance equipped with a three-prong plug in a receptacle accepting only two prongs. The "pigtail wire" on the adapter is grounded by the metal coverplate screw which connects to the already-grounded wall outlet box. In most farm and home wiring in South Dakota, a "third wire" to ground the box would have to be added (as shown in Figure 4) to make this work.

RECEPTACLES FOR LARGER LOADS



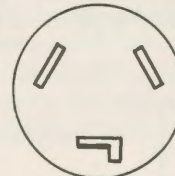
125 Volt Only
15 Amp.



250 Volt Only
15 Amp.



250 Volt
20 Amp.
Locking

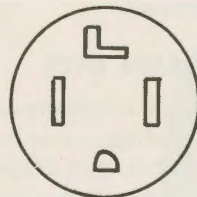


250 Volt
30 Amp.



250 Volt
50 Amp.

125-250 Volt
30 Amp.



125-250 Volt
50 Amp.

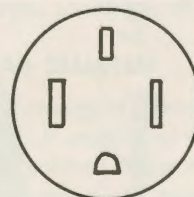


Figure 5. Depicted above is a variety of grounding type receptacles for different voltages.

GROUNDING HEAVIER LOAD APPLIANCES

Suitable receptacles for plug-in grounding of appliances of heavier loads and higher voltages than the standard 115-volt wall receptacles are available (shown in Figure 5). The voltages referred to are *maximum* voltages. Three-prong plugs are used where the load

operates only on 115 or 230 volts; four-prong plugs are used where both 115- and 230-volt loads are carried. The receptacle on the lower right in Figure 5 is required for service electricity to mobile homes.

GROUNDING FIXED EQUIPMENT

Some people have the mistaken idea that connecting an appliance to a driven ground rod will protect against electric shocks. The fallacy of this idea is dramatized in Figure 6. A ground rod in soil usually will not conduct enough current to blow the fuse and remove the danger of shock. Connection to water pipes has been permitted as a means of grounding in some areas in the past, but the electrical industry standards now call for a separate grounding wire from the frame of the appliance to the grounded neutral at the service entrance. In many cases water pipes are plastic and will not conduct electricity well enough for grounding.

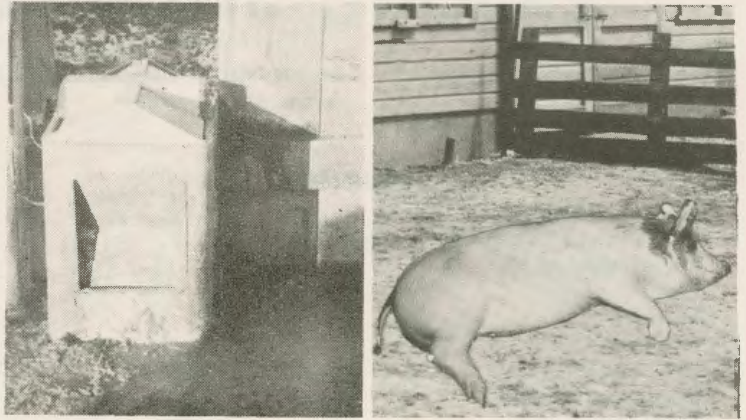


Figure 6. The electrically-heated waterer (pictured above), not properly grounded, killed this pig. The ground wire was connected only to a driven ground rod.

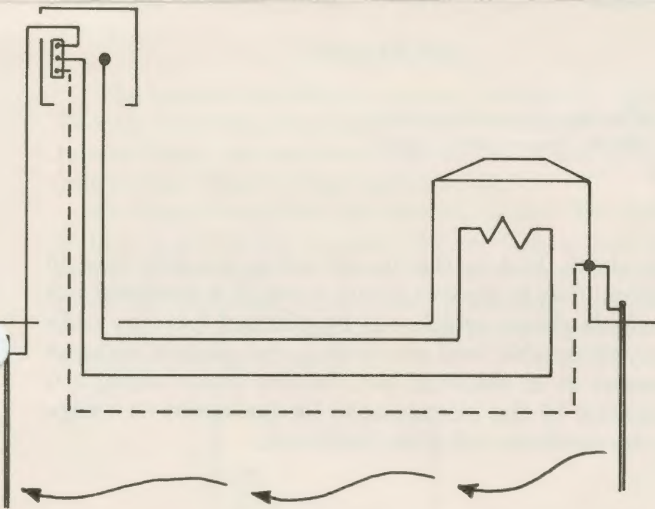


Figure 7. The curved lines with arrow points in diagram above show the poor path provided by ground rod through the soil. The dotted line shows good metallic path provided by a grounding wire (which usually is bare and enclosed inside the cable with the insulated wires).

DON'T DEPEND ON GROUND ROD!

A livestock waterer or similar appliance should be well grounded—in the manner shown in Figure 7. The dotted line indicates a good metallic path which will carry away potentially dangerous stray currents. The ground rod—though it may be useful in carrying away lightning surges, particularly if the waterer is located on a fence line—provides a poor path for stray line-voltage currents. Properties inherent in soil determine whether a particular soil is a good or poor conductor of electricity (for this reason **DON'T DEPEND ON A GROUND ROD TO PREVENT SHOCK**).

A driven ground rod usually will not carry away the danger from shock to a person standing on the ground. Here's why—the amount of current needed to cause a severe shock is very small. This amount will flow even if electrical resistance is quite high (as it is in some soils). To remove the danger of shock, an effective path of low electrical resistance must be provided (as in copper, silver, brass, etc.).

The resistance of soil is usually too high to do an effective job. Water pipes, even if they are made of metal, may have high-resistance joints and therefore may not be well enough grounded.

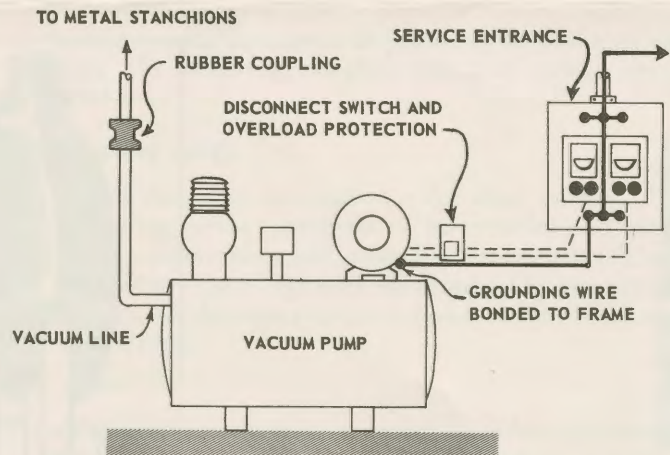


Figure 8. The disconnect switch box also is grounded, but not connected to the neutral wire in this diagram, which shows grounding connections for a milking machine.

EQUIPMENT THAT SHOULD BE GROUNDED

The following equipment should be grounded, either through a three-prong type receptacle or through permanent wiring:

HOME EQUIPMENT

Air conditioner
Drills, saws, and other
Portable hand tools
Clothes dryer
Furnace
Freezer
Garbage disposer
Bathroom heater
Mixer, food
Oven
Range
Refrigerator
Table saw
Washer (Clothes or dish)

FARM EQUIPMENT

Air compressor
Drills, saws, and other hand power tools
Ventilating fan
Electric fencer
Furnace
Heaters
Milk Cooler
Milking machine
Silo Unloader, conveyor, bunk feeder, and other motors
Water heater
Livestock waterer, heated
Water pump
Welder

Note: The above is only a partial listing. Grounding is advised for any appliance or device which, if energized, could cause a shock to a person or animal.

Some manufacturers are offering for sale "double-insulated" tools such as electric drills. "Double-insulated" tools are less likely to produce shocks than standard tools, but proper grounding of standard tools offers better and cheaper protection if grounding receptacles are available for use.

The "ground-fault-interrupter" is a device which will shut off the power if a person starts to get an elec-

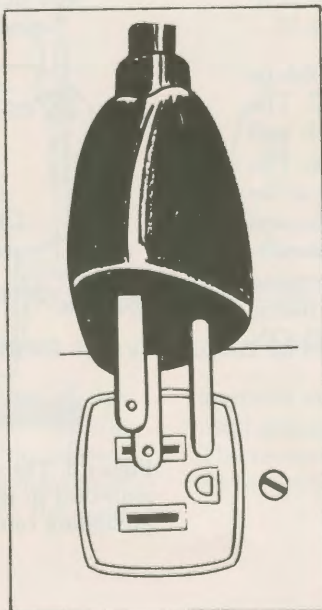
tric shock. It does this by detecting the difference in current flow in the two circuit wires. It is available as a portable device which can be plugged into any ordinary receptacle, and also to fit in the place of a circuit breaker in an electrical box. On new home wiring it is required by the electric code for protection of receptacles outdoors and in the bathroom.

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