Section Three

Basic Electrical Theory

When I was a kid, a very popular theme for an episode of a TV show was to have two heroes (or the hero and a wisecracking terrified bystander) defuse a bomb. The process of amateurs defusing a bomb invariably follows after they discover an armed bomb where either a fake one was expected or a live bomb was expected somewhere else. After discovery of the bomb, the reluctant amateur *ordinance disposal experts* (ODEs) go through a complicated process of opening up the bomb (careful to avoid any booby traps) only to be confronted with two wires. These wires are used to connect the fuse (the part of the bomb with the timer, optional remote control receiver, and any booby trap sensors) to the detonator (the part of the bomb that causes the high explosive to blow up). The bomb usually looks like it is wired something like Figure 3-1.

With the booby traps behind them and the bomb's components exposed, the heroes are always faced with the dilemma of which of the two wires leading to the detonator to cut (adding to the tension, just before they make their decision and cut a wire, the show cuts to commercial). Somehow they know that by cutting the wrong wire, the bomb would explode, but by cutting the right wire, the bomb would be defused and safe.

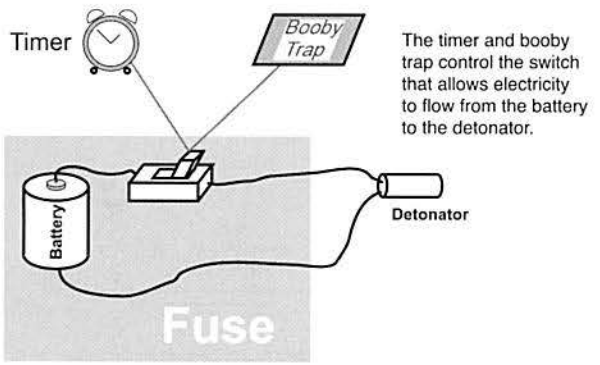

Figure 3-1 *Block diagram of a bomb circuit*

For some reason, nobody (and this includes the special effects crew responsible for explosives) seems to have told any Hollywood screenwriters that they could cut either wire leading from the fuse to the detonator and the bomb would be safe. As I will show in this section, electricity must flow in a closed circuit—in the TV shows then, once one of the wires was cut, current couldn't flow from the fuse to the detonator and back to set it off.

The bomb's fuse is represented by the switch and the battery. Electricity is produced by a power source (usually a battery), and when the switch is closed, electricity flows through the wires to the "detonator" and then back to the battery.

The detonator can be thought of as a "load;" its purpose is to convert the electrical energy into something useful. In an actual detonator, electricity passing through it causes a wire to heat up and a small heat-activated charge in the detonator explodes. When the detonator's charge explodes, the shock of this explosion sets off the high explosive of the bomb. It is not widely known by most people, but high explosives do not go off when they are exposed to extreme heat—they may burn fiercely, but they will not explode. It is the shock of the exploding detonator charge that sets them off.

It should go without saying that throwing a stick of dynamite, or anything else you might find that is labeled "explosive" onto a fire to see what will happen is *not* a good idea. Many different kinds of explosives, as well as different products (such as aerosol hairspray), will explode and/or throw off burning materials if exposed to high heat. When I discuss explosives in this section, it is for your edification, not as an invitation for you to experiment with them.

In case you didn't get it the first time; do not place items labeled "explosive" (or that have an explosive warning symbol) onto a fire or other heat source.

Benjamin Franklin said that electricity flows from the power source's positive connection to its negative when there is a path for it to follow. The black lines on a schematic diagram are used to represent the wires providing the path for the electricity through in the bomb's components. Looking at Figure 3-1, you will see that the different parts of the "bomb block diagram" are linked together in a closed loop—this is the closed circuit that is required to allow electricity to flow from the fuse's battery to the detonator and set off the bomb.

When a switch is said to be open, the contacts within the switch are not touching one another and electricity cannot flow through the circuit. This is the same as two wires held apart. When the contacts come together (as two wires held together), the switch and the circuit are described as being closed, and electricity can flow through them.

The need for a closed circuit for electricity to flow is the basic electricity rule that Hollywood screenwriters do not understand. In this section, I will expand on this basic rule and give you a better idea of what electricity is and how different values of it can be calculated and measured in a circuit.

In case you don't believe me about how bombs are treated in TV shows and movies, the following are some references in which the stars are given the task to defuse an explosive device they know nothing about:

Hogan's Heroes—"A Klink, a Bomb and a Short Fuse"

*M*A*S*H*—"The Army-Navy Game"

Get Smart!—"Stakeout on Blue Mist Mountain"

Mission Impossible—"Time Bomb" (although to be fair, in *Mission Impossible*, the team seemed to have to defuse at least one bomb every three or four episodes)

Laverne and Shirley—"The Right to Light"

FBI—"Time Bomb"

Ironside—"Not with a Whimper, but a Bang"

Barney Miller—"Lady and the Bomb"

Remington Steele—"Premium Steele"

Lethal Weapon 3—Riggs and Murtaugh blow up a building by cutting the wrong wire in a bomb that they are trying to defuse.

At the start of this section, I noted that the bomb-defusing process on TV was very similar and generally followed the same lines for each of the different shows. What is amazing is that when you watch these shows, you'll see that in virtually every case, the wrong wire is cut, which results in a few moments of panic. Afterwards, everyone is okay and enjoys a good laugh because the bomb turns out to be a dud, or it was wired incorrectly, or it wasn't the type of bomb that was meant to destroy things.