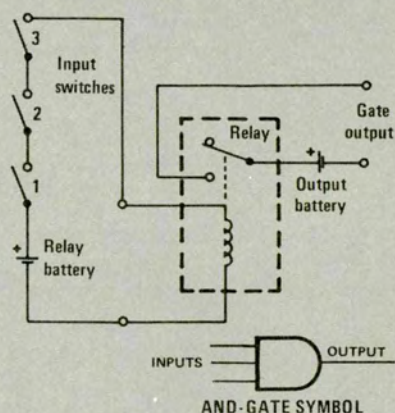# Basic building blocks for electronics projects: gates

Newcomers to electronics hear a lot about gates. But what the heck are they?

Thumbing through the pages of Modern Electronics, you'll find many small, inexpensive, and easy-to-build projects. The key ingredient in these "mini" projects, and the basic building block of even the world's largest computer, is the integrated circuit (IC) digital gate.
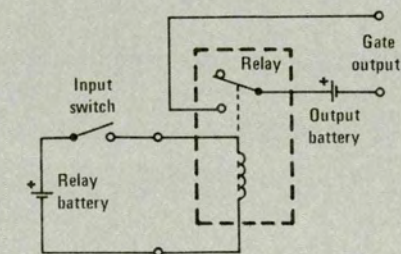
The digital gate in reality is nothing more than an educated "on-off" switch. You can get a better idea of what goes on inside an IC by looking at the diagram below. Here you'll see a simple relay circuit that

connects a battery to the output terminal when another battery is applied to the input.

Suppose you connected the relay battery through two or more switches as shown below. If you did, you could connect the battery

OR-GATE SYMBOL

to the relay, energizing it, by closing any one of the switches. Since you can connect the output battery to the terminal by closing input switch one *or* input switch two *or* any other input switch, this kind of circuit is called an *OR* gate.

If you connected your relay control switches in series, as shown below, you would have to close all
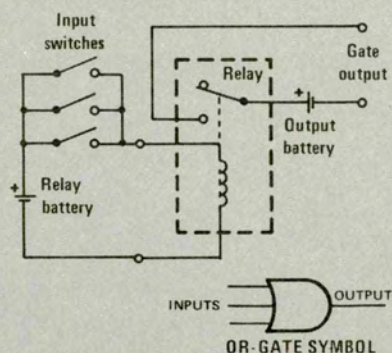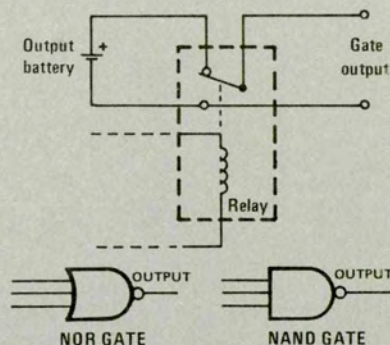

AND-GATE SYMBOL

of them before the output battery would be connected to the terminal. Since you would have closed switch one *and* switch two *and* every other switch in the circuit, this kind of circuit is called an AND gate.

The OR and the AND gates described so far have no output *unless* the relay is energized by closing the appropriate switches. Sometimes, however, you need a gate that provides an output *except* when the relay is energized. This is done by adding a connection to the relay contacts, as shown below. Gates that provide *no* output when energized are called NOT gates. So an OR gate becomes a *not-or* gate, or simply NOR gate; AND gates become NAND gates. NAND and NOR gates are distinguished from

NOR GATE   NAND GATE

AND and OR gates by a small circle at the output end of the symbol in schematic diagrams. —*Bob Margolin*