

## THE “IMPOSSIBLE” CIRCUIT

BAFFLE THE BOSS ...  
CONFUSE YOUR CHUMS ...  
JOLT THE NEXTDOOR GENIUS ...  
TEASE YOUR TEACHER ...  
NAG THE NEIGHBORS ...

By LUIS VICENS

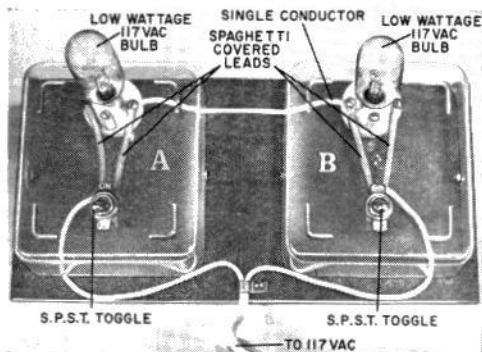
**Y**OU CAN do all of these things—and more—just by challenging your technically inclined friends to solve *The Case of the Impossible Circuit*. Pictured below, the circuit is really a very simple affair. It consists of two boxes, *A* and *B*, each of which contains a lamp and a switch. There is a single power line lead to each box and a single connecting lead

between the two boxes. Whenever a.c. power is applied and switch *A* is thrown *ON*, lamp *B* lights. When switch *B* is thrown *ON*, lamp *A* lights. When both switches are *ON*, both lamps light—and when both switches are *OFF*, both lamps are dark.

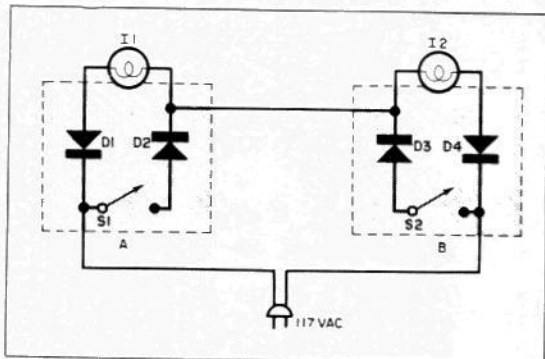
*Question: What is the circuitry in each box?*

*Clues: Neither box contains amplifiers, transformers, oscillators, nor relays. The circuits are essentially identical in both boxes. The lamps are standard, identical, ordinary household incandescent bulbs. The power source is a standard 117 volts a.c. But, most important—the circuit is a practical one which can be easily duplicated at home, either for demonstration purposes or as part of a science fair project.*

If you can't figure it out—or you think you have a solution and want to check it—turn to page 79.



# THE "IMPOSSIBLE" CIRCUIT MADE POSSIBLE



**ARE YOU STUMPED** by the "Impossible" Circuit on page 72? If so, don't be despondent—this seemingly innocent circuit has stumped even the best electronics engineers.

The "trick" in solving the circuit is to *think simple*. Obviously it is not a complicated design using multiple switches, tuned circuits, tunnel diodes, crossbar networks, filters, interlocked gate circuits, or similar techniques.

**How "Impossible" Circuit Works.** The circuit uses four standard diodes in addition to the lamps and switches. Circuit operation is possible because (A) diodes are unidirectional devices, permitting current flow only in one direction, and (B) an a.c. power source is used.

If both switches are open, the only current path is through diode *D1*, lamp *I1*, lamp *I2* and diode *D4*. But diodes *D1* and *D4* are connected "back to back" and each blocks current flow on alternate half-cycles. As a result, when the switches are both *OFF*, little current flows and the two lamps remain dark.

Suppose that switch *S1* on box *A* is closed. Diodes *D2* and *D4* are now connected in a series-aiding configuration on either side of *I2*. On alternate half-cycles current can flow through *S1*, *D2*, *I2*, and *D4*, and the lamp lights. Lamp *I1* remains dark because current flow through it is still blocked by *D1*.

Similarly, if switch *S1* is open and switch *S2* is closed, diodes *D1* and *D3* are in series, and current can flow through *D1*, *I1*, *D3* and *S2* on alternate

half-cycles. Lamp *I1* lights, and lamp *I2* remains dark, for current flow through it is blocked by *D4*.

When both switches are closed, both lamps light, but each only on *alternate* half-cycles of the applied a.c. voltage. However, the thermal lag of the incandescent filaments and persistence of vision combine to produce what appears to be a steady glow, so both lamps seem to be on simultaneously.

**Assembling the Circuit.** A demonstration model of the "Impossible" circuit can be assembled in a single evening. Neither layout nor lead dress is critical, nor—for that matter—are the component parts. Either standard (Edison) base or candelabra lamp bulbs can be used. The lamps are familiar 117-volt incandescent types, rated at from 7 to 60 watts—take your pick! The switches can be toggle, slide, push-button or rotary s.p.s.t. switches, while the diodes (*D1* through *D4*) may be anything with a 200-PIV (or higher) voltage rating and a 1-ampere (or more) current rating.

The boxes should be of transparent plastic and mounted on a sturdy base, with the external wiring clearly visible. Use an insulating material for the base, such as wood, Masonite, or clear plastic, to avoid the suspicion of a "ground return." The subminiature diodes (International Rectifier Type 804) can be concealed in short lengths of tight-fitting spaghetti tubing.

With *all* wiring apparently visible, the circuit becomes—as the King of Siam would say—a real *puzzlement!* -30-