Homemade launch control systems are among the items most frequently sold or bartered at swap meets. Some of the systems feature integrated circuit timers and light-emitting diodes that provide a visual countdown to zero.

4. Launch control systems

By David Babulski

Advances in model rocket ground support electronics have closely followed developments in solid-state electronics. In the early days, model rocketeers were content with simple manual DC switching devices to provide electrical power for engine ignition, Fig. 4-1. Because early igniters were made from Nichrome wire, a large amount of current was needed to heat the wire sufficiently to ignite the propellant in the rocket engine. A lead-acid car battery was the most common power source.

This technology worked well until rocketeers began clustering engines. Several igniters were connected in parallel so that all the engines in the cluster would ignite at the same time. At first, the answer to the need for a larger supply of electrical current was to use a bigger battery. Unfortunately, this proved to be very cumbersome, particularly for portable launchers. Because substantial current was lost in the wires from the launch controller to the launcher, a way of shortening the distance between the ignition battery and the igniter was needed.

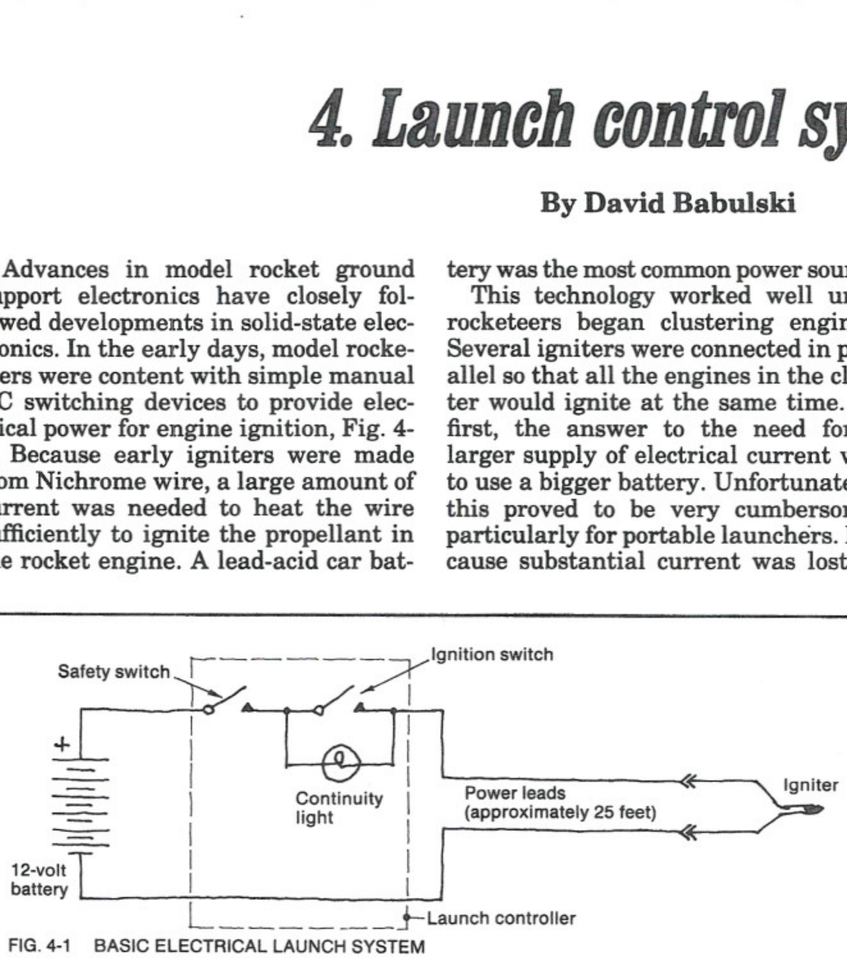


FIG. 4-1 BASIC ELECTRICAL LAUNCH SYSTEM

This gave rise to the next advance in ground support technology — the relay-controlled launch system. This system allowed the ignition battery to be placed close to the igniter while permitting the rocketeer to remain a safe distance from the launcher, Fig. 4-2.

A relay is nothing more than a switch operated by an electromagnet. A small battery in the hand-held portion of the launch controller supplies the operating voltage for the relay, which is located at the launcher. When the firing button is depressed, the relay actuates. A set of the relay's contacts close, completing the circuit between the ignition battery and the igniter.

This was an improvement over the earlier system, but was not without its problems. Relays are electromechanical devices, so they are subject to both electrical and mechanical failure, usually at the most inopportune moment. Relay systems are relatively expensive to operate, as well, because two batteries are required — one for the relay and one for the igniter. The slow rate at which ignition occurs is also a drawback.

The problems with relay-controlled launch systems led to the next development — the capacitive-discharge system, Fig. 4-3.

In general terms, a capacitor is an electronic device designed to store an electric charge and release it when needed. When used in a launch controller, the capacitor stores a large amount of power from the ignition battery and releases it through the igniter in a sudden pulse, ensuring fast, reliable ignition of single and clustered engines. With capacitive-discharge systems, the ignition battery can be reduced in size, lowering cost and increasing portability compared with earlier methods.

Capacitive-discharge systems were the accepted standard until the Estes Solar igniter and flashbulb ignition came on the scene.

The Solar igniter can be successfully ignited with the current from four small 1.5-V AA alkaline dry cells connected in series. As a result, the simple DC controller made a big comeback.

The simple DC controller could not be used for flashbulb ignition, however, because hobbyists soon discovered that the small amount of current in the circuit during a continuity check would set off the flashbulb. The search was on for a flashbulb-safe launch controller. The answer was found in the solid-state launch controller, Fig. 4-4.

With the solid-state launch controller, a transistor is used as a switch to complete the circuit between the ignition battery and the flashbulb. A tiny idle current through the transistor is used with a meter or piezoelectric alarm as a flashbulb-safe continuity check.

All kinds of variations have followed. The solid-state controller is frequently used in conjunction with the capacitive-discharge system and multi-pad systems have been developed with a separate transistor switch for each launchpad.

When low-cost integrated circuits became readily available, the automatic digital launch controller was the next innovation, Fig. 4-5. When the start switch is closed momentarily on the digital launch controller, the 555 IC timer generates one voltage pulse per second. These voltage pulses cause the digital circuitry to count down from 9 to 0. The MAN-7 is a light-emitting diode matrix which displays the count. When a count of 0 is reached, the 74190 provides a voltage pulse to the 2N2222 transistor. The transistor then acts as a closed switch to send current through the igniter. Thus, the digital launch controller is really a combination of digital electronics with a solid-state launch controller.

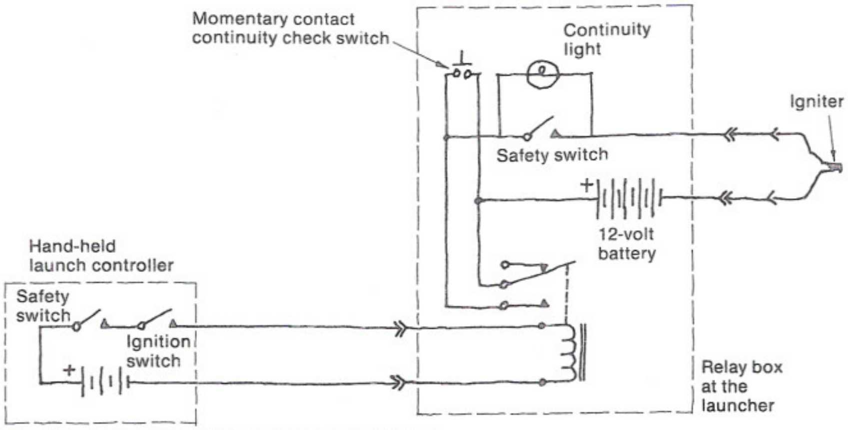
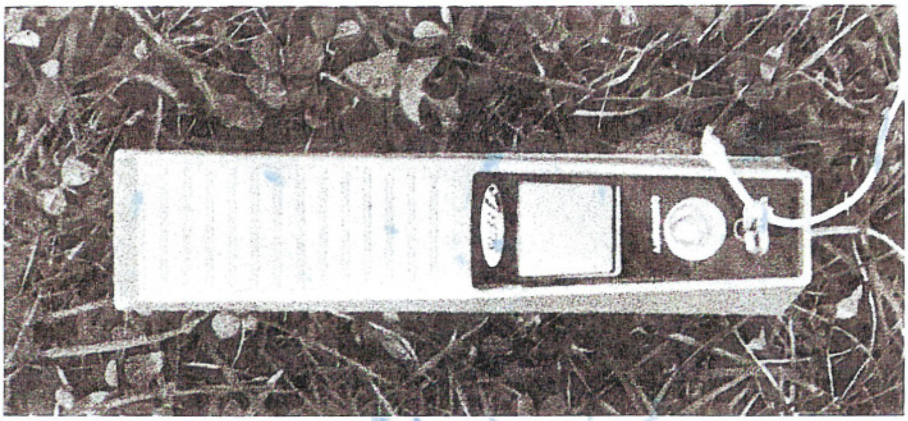


FIG. 4-2 RELAY-CONTROLLED LAUNCH SYSTEM



The widespread use of Estes Solar igniters (far right), which require far less current than earlier types, has made possible simple 6-V launch controllers that operate from low-current batteries. For example, the Estes Solar Launch Controller (above) operates on four 1.5-V alkaline AA cells; the Power-Pulse launch controller (right) uses a small 6-V Polaroid Polapulse P-100 battery.

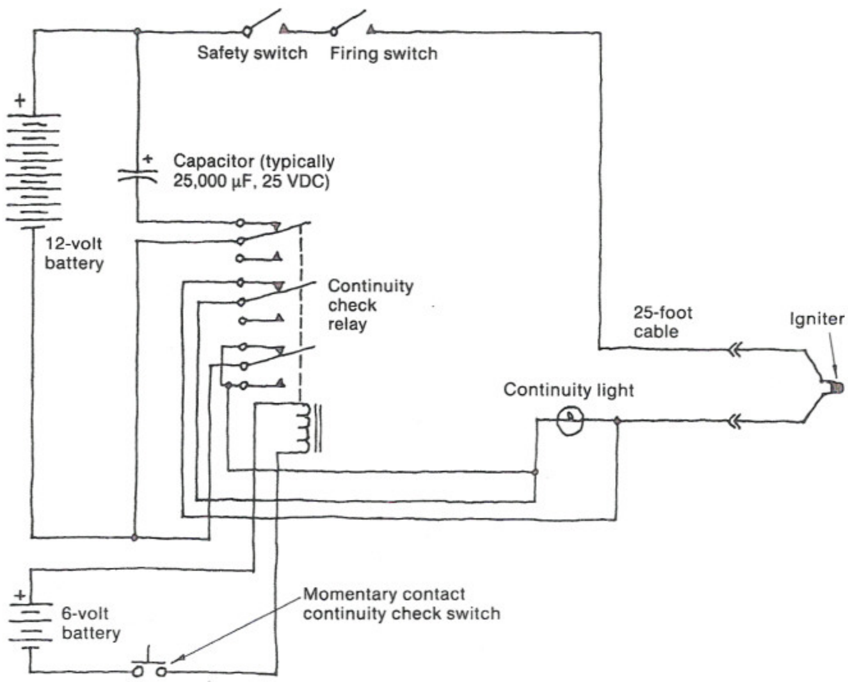


FIG. 4-3 CAPACITIVE-DISCHARGE LAUNCH SYSTEM

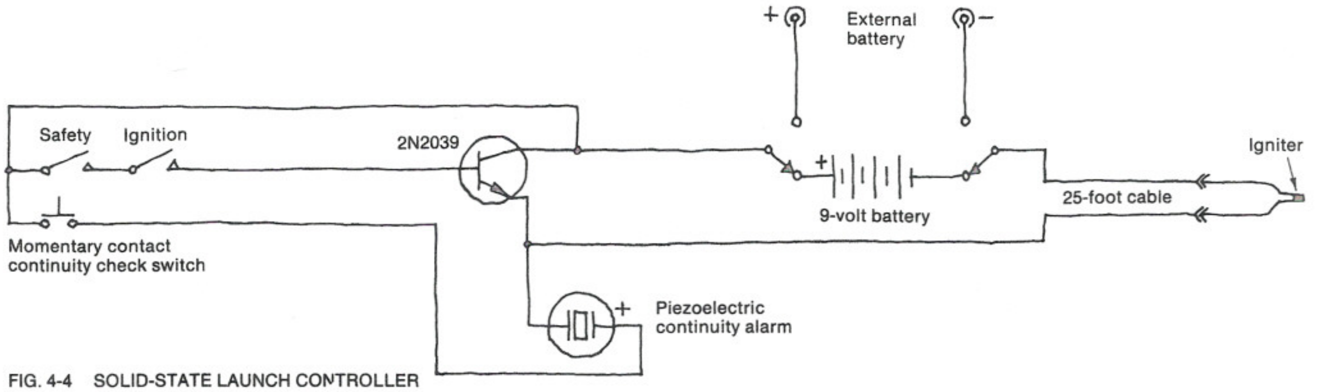
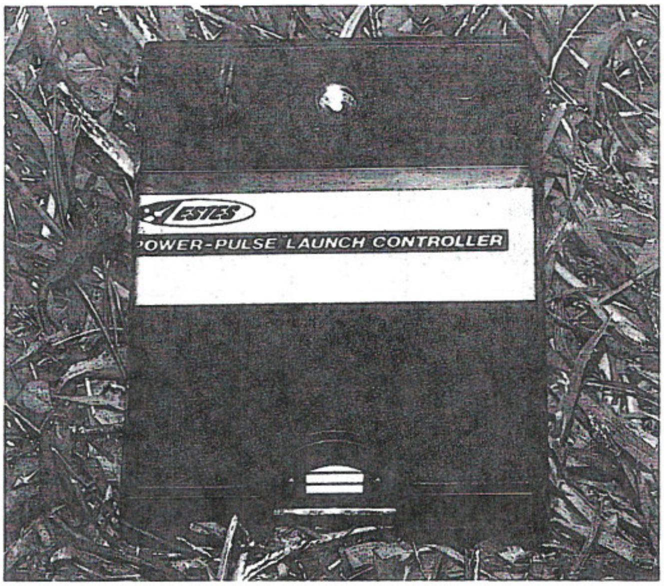
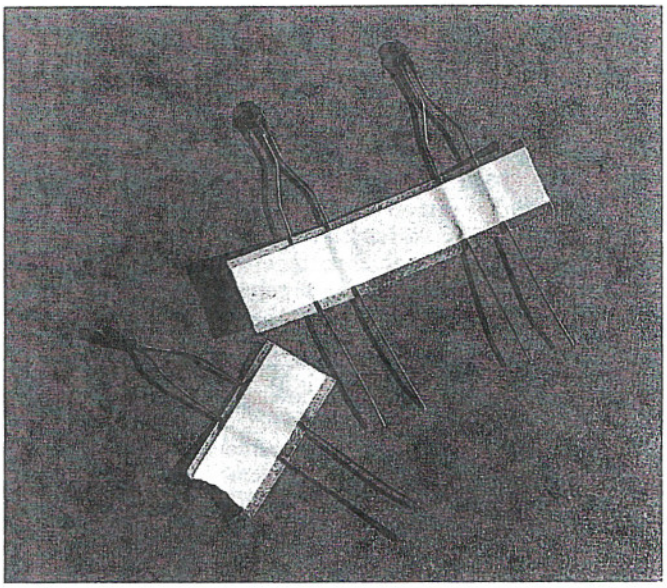


FIG. 4-4 SOLID-STATE LAUNCH CONTROLLER





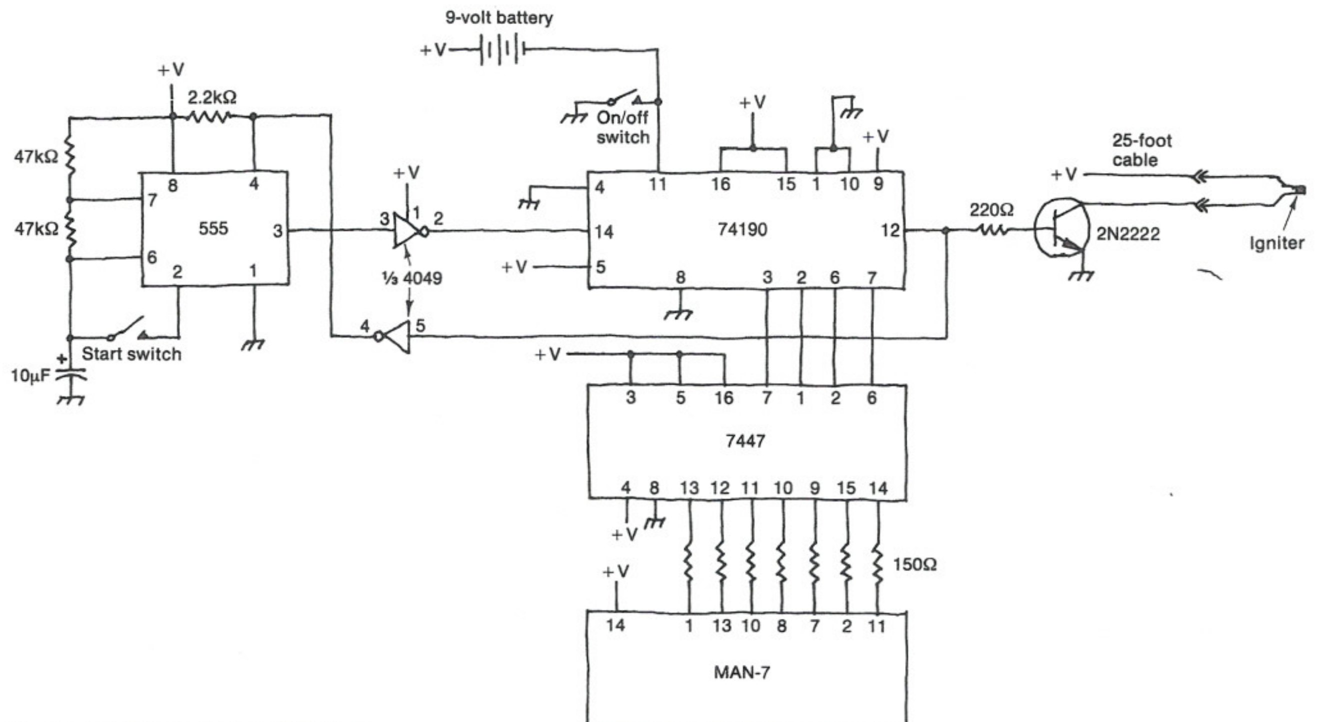


FIG. 4-5 DIGITAL LAUNCH CONTROLLER