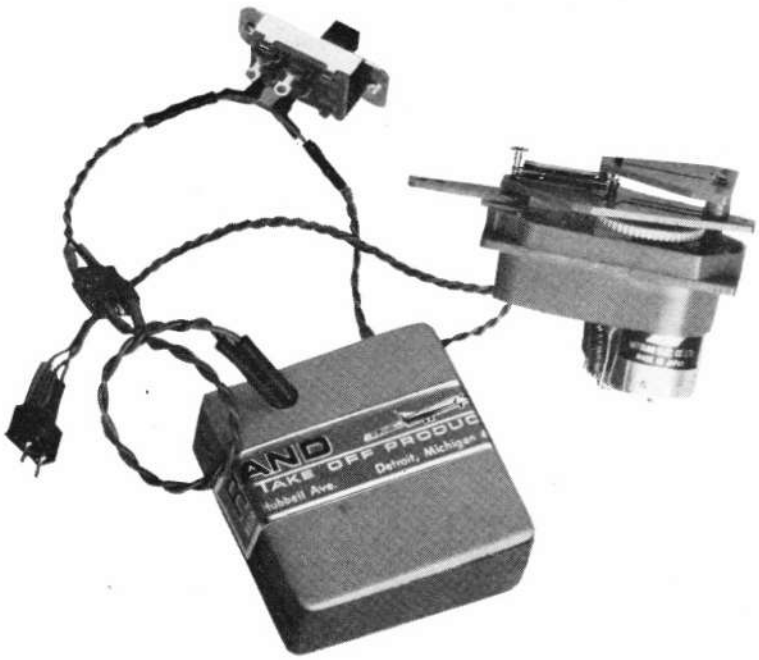

ELECTRONIC SWITCHING FOR *Galloping Ghost*

The introduction of the Rand actuator was a major factor in the new image of simple proportional. Now, the man behind the product goes a step beyond . . .

By Herb Abrams

EVER since starting in R/C and working with galloping ghost, I have been searching for a way to eliminate the need for the relay in the receiver and to eliminate the troublesome requirements for as many as seven cells in the battery complement. Judging from the number of modelers who have written and called me about their problems, I realized that they had been searching for the same thing.

Last summer at the NATS, I met Don Fisher of Whitewater, Wisconsin, who was flying a pulse rudder ship with 4 cells and an electronic switch to eliminate the relay. Don had many good ideas that aimed in the direction we were going at RAND. He had been working with electronic switches for the past six years. We discussed the various forms of electronic switching circuits and outlined more possibilities than one could imagine. Out of this we decided to develop an electronic switching circuit to meet three requirements:

1. It had to utilize only three cells and therefore two wires and a single-pole, single-throw switch to complete the harness.

2. The circuit had to be compatible with any 2½ to 3½ volt receiver and operate with or without the relay.

3. The circuit had to be quiet enough electrically to utilize the common battery supply for actuator and receiver.

Don and I felt these requirements would yield the lightest and most reliable system and still be economically feasible. The cost of the electronic switching circuit would be offset by the cost of the cells it would replace.

Let's look at the problems associated with the battery supply for galloping ghost. The main problem is R.F. noise from the actuator and relay being fed back to the receiver detector, amplified and sent to the actuator again, causing a phenomenon called "oscillation" of the receiver. The result is a solid signal "on" type interference. To limit or eliminate the problem, we use two sets of batteries, one for the receiver to provide a "quiet" supply and one for the actuator. However, this solution is costly and heavier than we would like. The separate battery to the receiver presents other complications. If we use dry cells, we find them undependable. The state of their charge cannot be determined by testing with a voltmeter. To increase the reliability of the receiver power supply, they can be replaced with nickel cadmium batteries. In order to have sufficient voltage, three cells are generally used, providing 3.6 V to the receiver. To save cost and weight, 225 Ma cells generally are used. However, this presents another irritation to the modeler. Unless he builds a special charging circuit, he finds he cannot charge 225 Ma nickel cadmium cells in the same circuit or on the same charger with his 500 or 600 Ma cells used for the actuator. The most reliable and convenient system would be three cells of 600 Ma capacity used for both actuator and receiver. And that is just what RAND has in the GG PAK!

The problem with the relay is that it is the main source of the R.F. noise fed back to the receiver detector. This noise is generated at the relay contacts (1) by the arc produced when they interrupt a heavy current, (2) by the bouncing of the relay contacts when rapidly making and breaking and (3) by the vibration of the contacts caused by the airplane engine. It can be seen that much of the R.F. noise would be eliminated if the relay contacts carry only 8 Ma signal current rather than the motor current which can be as much as 800 Ma. The GG PAK does just this when used with the relay. Therefore, reliability is improved to the extent that the relay contacts will not become pitted and dirty or create R.F. noise. However, the relay is still subject to vibration of the airplane. When using the GG PAK, the relay can be removed, thereby eliminating all of the problems associated with relays. We feel this relayless GG circuitry will give the modeler the most reliable system.

When the relay is removed from a receiver, a resistor is needed in its place to properly load the receiver circuit. We have included this resistor in the GG PAK circuit so the modeler will be able to remove the relay and merely connect a wire to the relay connection on the receiver p.c. board as an input to the electronic switch. The output of relayless receivers on the market is connected directly to the input of the switching circuit. If the modeler elects to keep the relay, he connects the positive side of the battery to the relay armature and the input to the electronic switch to the normally open connection of the relay. This way, when the relay is energized, the electronic switch receives a positive pulse signal. The GG PAK is supplied with all wiring, switches and plugs. The modeler has but three wires from the receiver to solder to the plug.

Don Fisher did a great job of designing the electronic switching circuit. Its action can best be compared to that of a double-pole, double-throw switch or relay. It uses all silicon transistors for the best temperature stability. The transistors are the latest available with cur-

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rent ratings well above our requirements. The action of the actuator and total system in the GG PAK performs beyond our fondest dream. Test flying this package, I was able to do maneuvers like inverted flying with the GiGi plane.

As we worked with the three cell battery, we recognized an additional benefit which we exploited to the fullest. By matching the rated voltage of the actuator motor to the three cell voltage, we had the lowest drain and best action with the galloping ghost actuator. We knew that increased voltage would cause the actuator motor to run faster. The actuator action would be improved. In the past, when voltage above 2.4V was applied to the LR 3, there were two drawbacks. There was a proportional increase in the current drain and unwanted motor control with the stick in the extreme position. We solved these problems with the GG PAK. We have matched the electrical characteristics of the motor to the GG PAK to provide a lower current drain at 3.3 to 3.6V operating range. We are able to retain faster motor control and improved action of the actuator without penalty of increased current drain or unwanted motor control. The actuator in the GG PAK is the same as the LR 3, but with the case changed to make room for the electronic circuit. The motor is similar to the one in the LR 3 but wound for 3V and available only with the GG PAK.

Batteries have been selected after careful investigation. GE cylindrical cells are our choice. A comparison of discharge curves indicates the cylindrical cells with self-sealing vent construction have a flatter discharge curve. Cylindrical cells maintain a higher voltage for a longer time. The self-sealing vented cells are designed so that they are not easily damaged from excessive charging or discharging rates or times. Quoting from GE, these self-sealing batteries may be left on charge for several weeks with no damage to the cell. On the other hand, button cells are particularly sensitive to overcharging. GE states that if the self-sealing cell is caused to vent, it will reseal and operate satisfactorily afterwards. We arranged to have these vented cells spot-welded together and packaged to provide the most reliable battery pack possible. 600 Ma cells operate the GG PAK for approximately 1½ hours before the voltage per cell is below 1.1 volts. The three cylindrical cells are arranged in a flat pack ⅝" thick, 1⅞" wide and 2" long and weigh approximately 3 oz. The modeler will find it easy to install in his airplane. He can place the battery flat against a bulkhead, a safe place in a crash.

We test flew the GG PAK with our Old Faithful GiGi airplane, using Min-X, Controlaire, and Citizen-Ship equipment. The airplane flew better than ever before because of the much lighter installation weight. Total installation weight of the GG PAK and receiver was approximately 6 oz. The GG PAK with its additional control provided more thrills. INVERTED FLYING! I even made a turn inverted. The throttle improved to the point where I was able to make touch and go landings using the throttle control any place in the landing pattern.

One of the lessons we learned during testing, that I would like to pass on to other modelers, is the effect of vibration on the actuator. We had been mounting the actuator solidly to a plywood plate, mounted solidly in the airplane. As vibration levels went up, problems of control became greater. The actuator in the GG PAK contains additional electronic circuitry and should be soft mounted as any proportional servo would be. I suggest that the actuator be mounted on a 1/16" plywood board which in turn is mounted with rubber grommets or foam strips to rails in the airplane.

The GG PAK will be a natural for the Midwest-RCM Air Race planes. These are recommended to anyone who wants a real challenge and plenty of fun!