Tech Tips 006

A help series

Dedicated to the dissemination of Detail model building methods and techniques.

Materials and methods presented here are not intended as the best or only solutions to the modeling challenge(s) discussed, rather as methods and procedures which have a proven record of success in actual use. Please keep experimenting with new materials and techniques, as this is the only way to expand the fields of knowledge.

John E. McCoy Sr. NAR-15731 – Rev. 04-15-2016

Black Powder Forever!

The Art of Clustering Black Powder Motors

A Guide to an Often Overlooked Area of Model Rocketry

Feb. 7. 1997 Re-release of April 4, 1991 CapCon91 article.

First: I am NOT a high power enthusiast. I do, however, enjoy working on giant scale, Sport Scale and Up-Scales of the classics models. So what does that have to do with black powder motors and clustering? EVERYTHING!

In my 25 years or so practicing in this great sport/hobby of ours, I've seen uncounted crashes, crackups, power prangs, chaffs, flameouts, blow-through, and all sorts of calamities befall the cluster enthusiast and the composite freak. In 1973, I said to myself, "Self", there *has* to be a better way to *reliably* ignite multi-motor models." I then tried flashbulbs with Thermite (not Thermalite) dare I say home rolled fuse. I tried separate lead lines to the individual igniters. I tried twisting igniters onto bus bars. I tried and tried, most only met with limited success (but several spectacular, shall we say landings).

Then someone introduced me to the **relay**. This one small device, and a little understanding of what must happen to clustered motors, has changed my thinking to such a degree that I no longer consider *any* cluster up to eight motors to be a "problem." The Author has now successfully flown 12 motor clusters with this technique.

The "system" I am about to describe has three phases. Phase one is the launcher/relay unit, Phase two is the battery(s), and Phase three is the igniter installation & connections. Let's take a look at each phase separately, bearing in mind that **each phase must be incorporated into the system as a single whole.**

Phase One: ***The launcher/controller.***

The relay launcher is an investment. Depending on the expected number of motors to be clustered, the relay itself can cost from $6.00 (for a 10 amp/contact, 12 volt DC coil at Radio Shack, part # 275-218) to $56.00 (for a Square-D super duty 40 amp/contact relay). This major component, with two to four micro-clip mechanically attached leads, does the critical work of delivering a minimum of 2 amps per igniter to the cluster. It is very important to have the power source as close to the igniters as practical, i.e. directly under the launcher, and connected to the relay line side with as heavy a conductor wire as possible (I use #8 THHN copper). The load (igniter) side wires should be kept to a maximum length of not more than 20 inches. Use a heavy enough conductor to handle a minimum of 10 amps per micro-clip (16 TFF copper wire will work nicely). All of this is connected to a three conductor (positive and negative in, positive out) control circuit. Arming continuity lamps or buzzers are at your discretion.

The control circuit activates the electromagnet in the relay which closed the ignition circuit, pushing all that current the remaining 18" with exceptionally little voltage, and more importantly, amperage drop to the igniters.

The entire electrical system can be enclosed in two enclosures. The first enclosure is a vented 3"x 5.25"x 5.875" metal cabinet. It contains the relay and connections.

A 3.0625" x 8.25" x 6.125" metal cabinet enclosed the launch control system. If using clusters in the E, F, and G class, the connecting control cables should be at least 35 feet in length. I've found that longer is always better all my launch systems except Micro Maxx launcher have 50ft of 16/2 White jacket stranded copper (Lamp Cord) control wires. However 35 feet will keep everyone the minimum distance of 30 feet from the launch pad, as required by the NAR safety code. Longer leads *are* always better. Better safety, better visibility, and better effect. (A complete parts list and wiring diagram to build your own Relay Launch system is included at the end of this article.)

Phase Two: ***The battery.***

One commonly observed mistake has been the attempt to launch clusters with insufficient battery power. Remember: 2 amps per igniter is a minimum. This means if you are using a dry-cell 6 volt lantern battery, or worse a hand held controller with 4 AA batteries; don't expect a reliable cluster even 3 motors. Rechargeable Hobbco gel-cel batteries are a bit better at 12 volt, but have a maximum amp output is only 7 or 8 amps. Three or four motor clusters will only get a dozen launches before requiring a fresh charge.

Be safe, not sorry; if you spend hundreds of hours building this beautiful giant scale cluster model, or Upscale Bird and it crashes because one or two motors failed to ignite due to low amperage, was the $12.00 or so difference between a 7 amp Hobbco gel-cel and a 65 amp motorcycle/RV wet cell battery worth it? Use a **good** 12 volt, high amp hour, "cold-cranking amp" battery. Sears Die-Hard Motorcycle and R/V Wet cells, or one of the newer high amp/hr gel-cel in the 26 amp/hr or higher range are recommended Take care of your investment. ***Charge your battery after each use.*** You won't be sorry, and it will last quite a few years. Remember purchase the highest amp/hour battery your budget will afford.

Phase Three: *The igniters.*

Igniter technology really hasn't changed much over the last 15 years or so. To generalize, they are basically a pyrotechnic tip on a fine nichrome wire. Given this "consistency," it's hard to believe the number of misfires caused by improper igniter installation. However, it is seen in all levels of the hobby. There have been a couple of newcomers to the igniter market of late, many of which may hold promise for clustering. As the research goes on we well keep readers informed. For now we'll look at the most common and available igniters: the" Estes Solar Igniters", and now the pyrogenless Estes "Starters".

First I highly do NOT recommend the new Estes starters for any cluster application. Use some form of pyrogen tipped igniters for all cluster motor combinations…even Micro Maxx motors.

One of the very best cluster igniters I've come across is ***Quest Aerospace Q2g2*** low current igniters. They require much lower 12V current then the "Normal" 2 amps per igniter. They are however somewhat in short supply.

I realize that people come and go in this hobby, but surely igniter procedures have been written down before this...or have they? Well, let's assume they haven't, and look at each step.

Upon opening the plastic packet of six igniters, we find three 2 unit strips connected by a tape strip. The first step is to separate one from another with scissors or a knife. With the two separated, we ask, Gee, do I really need all that extra tape and backing weight pulling down on the igniter after it is inserted? The answer is no. Trim the excess tape, leaving about a 1/4"tab on each side of the wires.

The wire itself appears to be very heavy, about 30 gauge steel or copper. Both wires taper from about 1/4" wide at the tape to approximately 1/16" near the pyrotechnic mass at the tip.

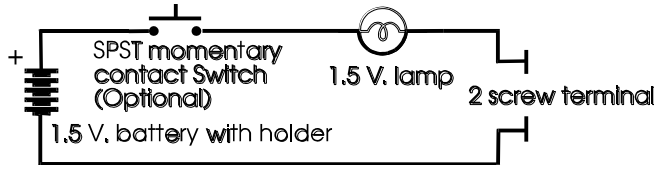
We also notice that several units in this packet have the wires touching just before entering the pyrotechnic tip. **This is a problem that must be corrected prior to installing the igniter.** This condition will cause the igniter to short out across the touching wire, and probably not get hot enough to ignite the propellant.

To correct this condition, hold the igniter firmly by the tip, then use a pencil, pen, nut meat pick, or similar pointed object to carefully separate the wires. Do NOT break the pyrotechnic tip in the process. If that occurs, throw the igniter away.

Now inspect the pyrotechnic material on the tip for damage. Inside the pyrotechnic material is a very, very thin 38ga. Nichrome wire (about 1/2 the diameter of the wire you can see.). This is the wire that glows red hot when subjected to as little as 6 volts. This ignites the tip material, which in turn ignites the propellant. This hair-thin wire is very brittle. Care must be observed in the storage and handling of these igniters.

If some of the tip mass is missing, we can check the continuity of each igniter **before** inserting it in the motor. This is accomplished through the use of "AA" battery and a 1.5 volt bulb (see figure 1 for tester wiring diagram). This is touched to the igniter leads. If the bulb lights, the igniter is good; if the bulb doesn't light, discard the igniter. Note that the parts list catalog numbers are from Radio Shack but any electronic parts will do.

Pocket Continuity Tester



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Parts list

1-270-230 Box
1- 270-401 AA battery holder (AAA will also work)
1- AA battery 1.5 volts
1- 275-1547 SPST momentary contact switch (Optional)
1- 276-080 chrome T-1 3/4 lamp holder
1-272-1139 1.5 volt T-1 3/4 lamp
1- 274 620 2 screw terminal strip. (remove phono socket)

Figure 1

With a good tested igniter in hand, insert the tip into the nozzle of the motor. Slide it all the way in until it stops against the propellant. Take a small piece of flame-proof wadding, roll it into a ball, and insert it between the igniter leads extending from the motor. (Authors Note: I do not recommend the use of Estes igniter plugs in clustering). Gently but firmly, pack this wad into the nozzle opening with a pencil, pen, or other pointed item. NARHAMS' own Paul Miller introduced me to the nut meat picker, which works very well.

Bend the igniter leads to one side and place a piece of 1/2" masking tape over the entire nozzle/igniter joint and press it firmly in place with your finger.

Re-test the assembly with your pocket continuity checker. If the bulb lights, you are good to go. If the bulb doesn't light, remove the igniter and start the whole thing over again with a good one.

OUCH!! HAND CRAMP!!!!!! Now I know why this procedure hasn't been written down before! Oh, that smarts. The whole procedure takes a lot less time to actually do than it does to explain on paper. Thank the lord for computer word processors.

When clustering motors, this procedure is even more important, as each igniter **must be good** after insertion into the motors. This takes time. The way I ensure proper installation is to do it the night before the launch on the kitchen table or in the hotel room. There you don't have to fight the weather, you have a good solid work area for tamping, and, most importantly, your concentration is focused on igniter insertion, not the next competitor's RG flight, or that pretty lady spectator over there. **Hey, stuff happens!!!**

Once you have all the motors with "good" igniters ready, **carefully remove** the igniter lead separation tapes from all the motors used for the flight. I generally slide the tape off by placing the motor on a hard surface, putting my thumb over the igniter/nozzle, and pulling the tape off at an angle with my other hand while pressing the nozzle with my thumb.

Now install the motors in your model. Care should be taken to avoid igniter lead/motor retainer clip contact. Position the motors to allow the various igniter leads to make contact between motors. Use a pair of needle nose pliers to twist one lead from two adjacent motors, thereby forming positive/negative alternating contact points for the micro-clips (see figure 2).

Once all connections between motors have been made, recheck continuity, have the model safety checked, place the model on your launcher. Carefully connect the alternating positive and negative micro-clip leads to the currents points and open leads (you will **always** be using an **even number** of positive and negative micro-clip connections).

Now have a successful cluster model launch!

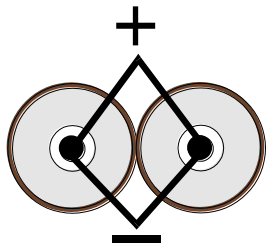
Building a Reliable Relay Ignition Launch System

You may be interested in building your own relay launch system. If that's the case, below is a list of the necessary parts and the wiring diagram. All parts listed are available at Radio Shack, except those preceded by a *. Those may be purchased from any electrical supply house.

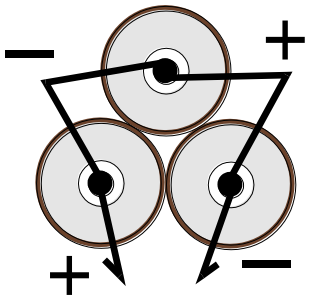
*1 one each: Square D #8501, type CDO-16 series B DPDT or SPDT **40 amp** relay with 12 VDC coil
2 OPTIONAL - one each: #275-218 Radio Shack DPDT 10 amp 12 VDC 130ms coil relay
3 one each: #270-253 3" x 5.25" x 5.875" Radio Shack metal cabinet (relay enclosure)
4 one each: #270-216 8" x 10" x 4" Radio Shack control console cabinet.
5 three each: #274-002 chassis mount four pin socket
6 three each: #274-001 four pin plugs
7 two each: #274-620 two screw terminal
8 two each: #275-1533 SPST standard toggle switches (one optional)
9 two each: #275-1566 N.O. SPST momentary contact switches (one optional)
10 one each: #270-1754 0-15VDC panel mount meter (optional)
11 two each: #272-340 lamp holders E-5 base (T-1 3/4 bulbs)
12 two each: #272-1143 12V T 1 3/4 75ms bulbs
13 one each: #272-331 high brightness red lamp assembly
14 eight each: #270-373 1 1/8" all purpose microclips
15 one set: #270-343 30 amp HD battery clips
*16 six each: #8 copper lugs
17 thirty feet of spiral wrap
18 one each: #274-251 open circuit two-conductor open frame jack (safety disconnect)
19 one each: #274-287 red 1/8" two conductor phone plug (safety disconnect key)
*20 one hundred feet of #14 THW 1000 volt 90 deg. C fixture wire or equivalent (need three 30 foot lenghts)
*21 ten feet of #8 THHN stranded copper wire (two five foot pieces)
*22 twenty feet of #16 TFF stranded copper wire.

Common Cluster Igniter wiring diagams

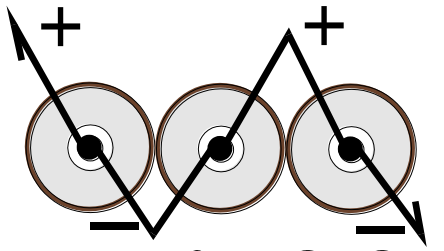
drawing by John E. McCoy sr. - NAR-15731 - Feb. 9, 1997



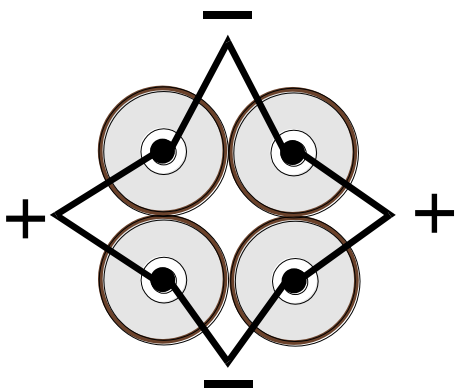
2 MOTOR



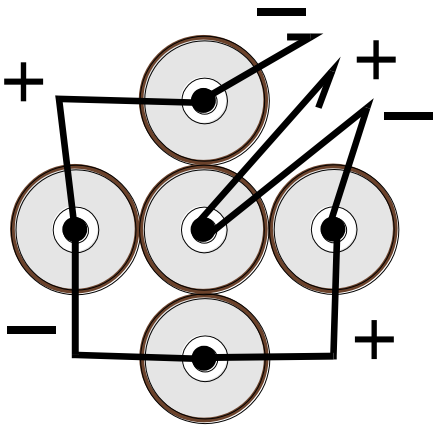
3 MOTOR



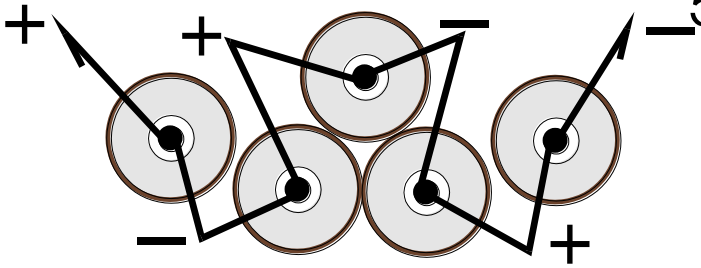
INLINE 3 MOTOR



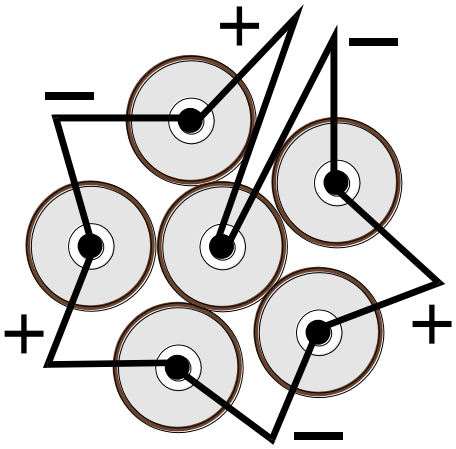
4 MOTOR



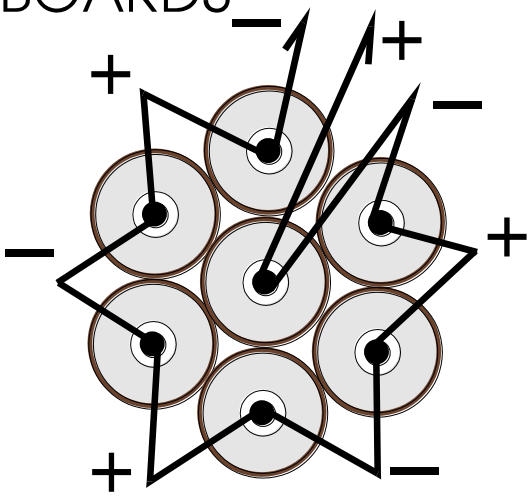
5 MOTOR



5 MOTOR W/ OUTBOARDS



6 MOTOR



7 MOTOR

Relay Ignition System Wiring diagram.

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