

**Beginner Project...****Page 1**

## Color Changing Stick Wheel

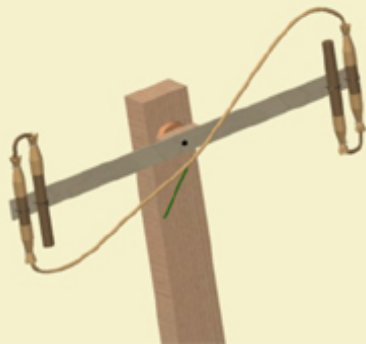
by *Michael Fales*

Figure 1: The completed wheel mounted on a 2x4 post.

### Materials:

- ▶ 1-1/4" wide by 24" long strip of thin plywood
- ▶ 3/4" x 3/4" by 4" long piece of pine
- ▶ 2" square or round of 3/4" thick pine
- ▶ 32" of 19 gauge steel wire
- ▶ 6 pieces of lightweight kraft paper 3" x 6"
- ▶ Approximately 46" of quickmatch
- ▶ Approximately 9" of blackmatch
- ▶ 2 3/4" ID x 4" long parallel wound tubes
- ▶ 2 1/2" ID x 6" long parallel wound tubes
- ▶ 4" length of safety fuse
- ▶ 1 3-1/2" long x 1/4" lag screw
- ▶ 2 3/4" #6 wood screws
- ▶ Cotton or linen string
- ▶ PVA or Wood Glue
- ▶ Mounting Board (10' long 2x4)
- ▶ Bentonite clay
- ▶ [Tourbillion Formula](#)
- ▶ [Color Driver Formula](#)



Figure 2: Wood pieces used to make the frame.

### Introduction:

This wheel is easy to produce and will create a large spray of sparks and color that will awe even a jaded crowd. By transitioning from the color drivers to the tourbillion with titanium drivers (referred to as BP Titanium drivers through the rest of this article), the effect grows to a huge finish. It can also be used as soon as you finish it as there is no drying time or pasting required.

### The Hardware:

The drivers are attached to a 24" flat stick of wood. Thin plywood works very well for this purpose because of its strength and resistance to warping. Thin strips of lumber will tend to warp or twist with the grain and will not provide adequate strength. Rip a 1-1/4" wide strip of the plywood and cut to 24" long. A small spacer is attached to the center of the stick to avoid collision with the mounting post while spinning. Cut a 4" long 3/4" x 3/4" piece of wood and clamp it to the center of the stick with a bead of wood glue between the two. Finish attaching the stick to the spacer with two 3/4" x #6 long screws inserted into 3/32" diameter predrilled holes to either side of center. The predrilled holes are necessary to keep the small pine spacer from splitting while inserting the screws. Drill a 9/32" hole through the center of the face of the stick and completely through the



Figure 3: Reinforcing the hub with a block of wood.



Figure 4: Drilling holes for tie-wires to pass through.



spacer. This will be the pivot point for the wheel. Cut a 2" square or disk of 3/4" thick wood and drill a 5/16" hole through the center (a plug from a hole saw will work just fine). This will become a large washer to reduce friction between the spinning wheel and mounting post.

#### **The Drivers:**

A total of four drivers will be used with this wheel however you can scale up or down as you want. The drivers are sequenced to fire on opposite ends of the stick at the same time and are measured carefully to create a simultaneous change in effect. Both of the following compositions contain titanium and pressing is required rather than ramming:

#### **Black Powder Tourbillion Formula (Ronald Lancaster)**

*Meal D 35*  
*Potassium Nitrate 45*  
*Charcoal AF 15*  
*Sulfur 5*  
*Total 100*

Personal notes regarding this composition: I use straight ball milled meal for the Meal D and I find that the particle size in the composition is so fine that it will act like a fluid while pressing or ramming. It can flow right out the top of your tube and in your face while pressing! Granulating the mix will take care of the dust problem, which involves adding about 20% water to the composition, pressing it through a window screen and allowing it to fully dry. The resulting particles hold together well enough to reduce dust by preventing them from blowing by the rammer, but are still weak enough to crush into a solid powder grain when pressing. Adding +10 titanium gives a great shower of white sparks; however you should PRESS rather than ram the composition once you add the metal to the mix!

#### **Purple Driver Formula (John Glasswick)**

*Red Gum 10*  
*Parlon 20*  
*Magnalium 20*  
*Titanium 15*  
*Strontium Nitrate 25*  
*Cupric Oxide(black) 10*  
*Potassium Perchlorate 25*

These compositions burn with considerable heat and pressure which require a strong tube. The color drivers are created using Wolter Pyro Tool's 3/4" driver tooling shown in Figure 5. You can also use the simple home-made tooling as shown in Figure 7 with the BP titanium drivers and then drill out the nozzle hole by hand.

The color formula will provide a long burn time in just a 4" long tube. Place the tube over the spindle on the base and insert 1-1/2 teaspoons of clay. Press the clay nozzle hard using the hollow rammer. The nozzle will have to withstand pressure as well as erosion from burning titanium. Insert 1 teaspoon of color composition and continue to press using the hollow rammer until you clear the nozzle spindle. Switch to the solid rammer and continue pressing increments of color composition until you reach 3/4" from the top of the tube. Make sure to mark the tube where you stop so that you can fill both tubes to the same height. Fill the remaining cavity

Figure 5: 3/4" driver tool set with some strong driver tubes.



Figure 6: Pressing the color driver on an arbor press.



Figure 7: Home-made tooling for the 1/2" driver.

with loose clay and press solid (approximately 3/8" thick plug). Remove the driver from the tooling and repeat with the other 3/4" driver tube. Take both drivers outside and away from flammables. Drill, by hand, using a 1/4" bit into the solid clay plug just into the color composition on both drivers. These holes will be the passfire from the colored drivers to the BP titanium drivers.

The BP titanium drivers are created using a home made set of tools which consist of a plywood base with a 1/2" diameter 1/4" tall nipple and a set of solid 1/2" diameter rammers. This formula burns fierce and fast so the tubes must be 6" or longer to produce a good burn time. At this length the 1/2" tube will need a reinforcement sleeve to keep from buckling or splitting under the pressure of pressing. Some use a split PVC sleeve in conjunction with pipe clamps. A piece of 3/4" copper pipe can also be used as a pressing sleeve. This particular Skylighter tube fits a little loose in this pipe so I wrap a few turns of 30 pound kraft before inserting snugly into the tube. Place the tube on the base and insert 1 teaspoon of clay. Press the nozzle plug hard and solid just as with the color drivers. Insert 1/2 teaspoon of non-granulated or 3/4 teaspoon of granulated BP titanium composition and press solid. Continue to press the driver composition increments until you reach 5/8" from the top of the tube. Fill the remaining cavity with clay and press solid. It helps to switch to as short as rammer that is still practical while filling the tube. This will keep things vertical and reduce binding. Take both BP drivers outside and away from flammables. Drill, again by hand, using a 1/8" drill bit into the center of the nozzle plug end into the BP composition. Make sure to enter the composition about 1/4" to provide enough surface area to take fire as the wheel will be spinning.

Mix up a small amount of slurry of NC lacquer and meal powder. Cut six 1-1/2" pieces of black match. Two of the pieces will fit into the smaller 1/8" diameter nozzle end of the BP drivers and four of the pieces will fit into the holes at both ends of the color drivers which are 1/4" in diameter. Prepare the drivers by inserting a few grains of fine grained black powder into the nozzles to help insure ignition. Dip one end of each piece of black match into the slurry and insert it into the drivers. Make sure that the blackmatch makes good contact with the black powder and composition behind the clay plugs. After the slurry is dried, nose the drivers with 6 pieces of light weight kraft paper cut to 3" x 6". Apply glue as shown in Figure 10. Wrap the glued paper around the last inch of each end of the colored drivers and the nozzle end of the BP titanium drivers.

#### Attaching the drivers:

The drivers on this wheel are placed so that it will change rotation upon color change. The rapid slow down and slight pause before reversing gives a nice effect of white titanium sparks. Measure in from each end of the stick and mark the center at 1/2", 1-1/2", 2" and 2-3/4". Drill through the stick using a 1/16" bit at each of the 8 marks. Cut 4 pieces of 19 gauge steel wire approximately 8" long. Center the colored driver within the first two holes on the end of the stick and make sure the nozzle is pointing the correct direction. Squirt a small amount of hot glue between the driver and the stick to hold the driver in place until the wire is attached. Place a BP titanium driver between the second set of holes with the nosing positioned next to the passfire end of the colored driver. Secure the driver with hot glue. Attach the other two drivers on the opposite end of the stick making sure to point the nozzles in the correct direction. Bend the wires into a "U" shape and insert each over a driver through the tiny holes previously drilled. Pull the wire underneath the stick and twist tightly with pliers to lock the driver in snug. Cut off the extra wire about 1/4" up from the stick.

#### Fusing the drivers:

Cut two 8" pieces of quickmatch and bare the last inch of each end. Insert one end of the quick match into the nosing paper of the BP titanium driver and the other end into the passfire nosing of the colored driver. Tie the nosing paper down onto the quickmatch and secure the quickmatch with a small dab of glue between the nosing paper and quickmatch paper. Cut a 30" piece of quickmatch and bare the last inch of each end. Insert each end into the nozzle end of each colored driver and tie the nosing paper down onto the quickmatch and





Figure 8: Pressing the 1/2" driver on an arbor press.

secure with glue as before. Cut a small slit near the center of the long piece of quickmatch and insert a piece of safety fuse. Hold the fuse in place with a couple turns of masking tape.

#### Mounting the wheel:

Find a wide open space free from flammables. As seen in Figure 13, this wheel can spray titanium sparks up to 32 feet in diameter. Secure an 8 or 10 foot long 2x4 upright in the ground by burying securely. The 2x4 should be held firmly in place as the wheel will be spinning with great force. Pre-drill a 3/16" hole 2" down from top of the 2x4. Insert a 3-1/2" long by 1/4" lag screw through the center hole of the wheel followed by the wooden washer. Screw the lag screw into the predrilled hole on the 2x4 making sure to leave the wheel free to spin but tight enough to keep the wheel from wobbling back and forth. The lag screw may seem too long for what is needed, but shorter lag screws typically don't have a smooth shank behind the head that will allow the wheel to spin freely. Light the safety fuse, get back and enjoy. After the wheel has cooled you can clip the wires and remove drivers and the stick can be used again and again. 🔥



Figure 9: Fusing and priming the drivers.



Figure 10: Applying the outer nosing paper.



Figure 11: Securing the drivers in place with hot glue and wire.



Figure 12: Fusing the drivers so the end of the 3/4" color driver ignites the 1/2" silver driver.



Figure 13: The silver stage of the wheel on display in a field.

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