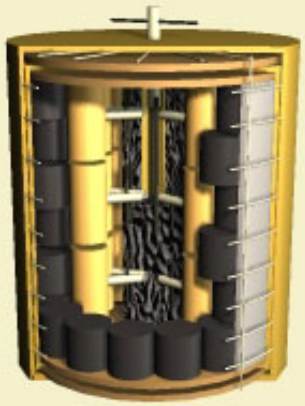
Build This...

5" Comet Shell with Scatter Stars



July, 2004 Issue

Build This:
5" Comet & Scatter Star Shell

Technique:
Using Star Plates

Technique:
Working With Paste

Tool Tip:
Home-made Star Plate

Class C Corner:
Angler's Ambition, ShowBiz

Summary:
This shell breaks with five rings of large comets, then surprise the viewer with an outbreak of asymmetrical scatter stars that dart in all directions. "They aren't go-getters, they aren't crossettes... what are those things?"

Prerequisite: 5" Comet Shell

Materials:

- (3) strips 24" long x (comet height x row count) + 3-3/4" wide 70lb virgin kraft, grain short (case)
- (1) 23" long x (comet height x row count)+1/4" wide chipboard, grain short (liner)
- (3) 24" long x (comet height x row count)+6" wide strips 70lb virgin kraft, grain short (paste wrap)
- (1) 36" long x (comet height x row count)+10-3/4" strip of 30lb kraft, grain short (outer wrap)
- (4) 4-1/2" kraft or chipboard end disks, 1/8" thick
- (1) 2" piece of time fuse (2.2 ft/sec)
- (1) 3/8" ID x 2-1/2" long pipette (2-3 turns of 70lb kraft)
- (1) 5-1/2"" of 4 strand cross match
- (1) 1" piece of 4 strand cross match
- (1) 17" piece of 8 strand black match
- (1) 30" quickmatch leader
- 70 3/4" dia x 7/8" long comets
- 60 3/8" pumped stars
- 30 1-1/2" long tubes, 7/16" I.D., 5/8" O.D.
- 30 1-1/8" long segment of time fuse

Tools:

- 4-1/2" dia. case former
- Rubber mallet
- 1-5/8" OD dowel or pipe
- Cross match punch
- 7/32" drill bit
- Hot glue gun
- 3/4" comet pump
- Brass hammer or 2 ton arbor press
- Scissors
- Anvil cutters

Unmeasured Materials:
flax twine, 2Fg black powder, 2FA black powder, white glue or wood glue, masking tape, wheat paste

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Volume 4, Issue 4

5" Comet & Scatter Star Shell...

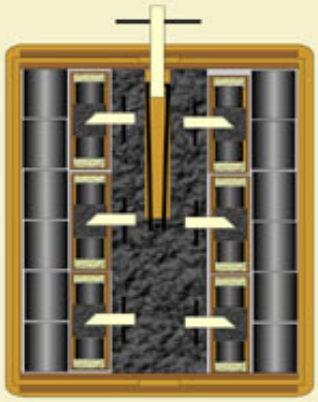

Figure 1: Arrangement of comets and scatter star inserts.

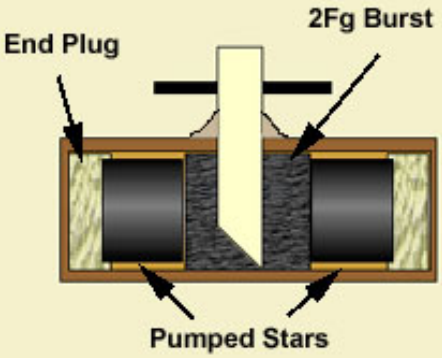

Figure 2: Scatter star components.

Figure 3: Trial fitting shell components onto a 4-1/2" dia. disk.

Introduction

Scatter stars are a unique type of insert shell that fires two stars in opposite directions. They are generally fired in clusters so that the cumulative effect is a dark break followed by a surprise of stars darting around with no symmetry or central point of origin. The use of scatter stars in this project is combined with a comet break canister shell, such that the viewer is first treated to a nice break of big comets, with a short delay before revealing the unexpected cluster of scatter stars darting in every direction. I used a three break version of this shell in competition some years ago, with each break featuring charcoal streamer comets with a different color scatter star. It was quite the crowd pleaser and took 1st place!

Figure 2 shows the basic components of a scatter star. They are really like a very short roman candle that fires out both ends simultaneously. Chinese scatter stars tend to use longer tubes with smaller diameter stars than those used here. They also make plastic moldings that feature stacked scatter stars that fire in alternating directions. A similar effect is depicted on page 264 of Shimizu's book Fireworks, the Art, Science and Technique. Here they are referred to as "ascending separating stars," since they are a grouping of scatter stars stacked on top of a shell to be used as a rising effect.

I have adapted these scatter stars to use typical go-getter type casings. The ones used here are item #T-137 tubes from Skylighter, which are 1-1/2" long x 7/16" I.D. x 5/8" O.D. One design issue with scatter stars is that the contents do not fill the entire length of the tube, so some filler must be used at each end. It really takes very little 2Fg black powder at the center to fire the stars, roughly 1/4 teaspoon. If the tubes are too short, then the stars won't travel as far. Thus the empty space at both ends must be plugged as seen in Figure 2.

Since the scatter stars shown here will be used as insert shells, they must be able to withstand the breaking pressure of the shell they will be used in without prematurely igniting. If the shell breaks and one or two stars are seen right away, the surprise will be spoiled. The areas prone to gas leaks are the end plugs and the point where the time fuse penetrates the side wall.

The amount of confinement is also critical to making good scatter stars. Too much confinement can result in the thin casing bursting apart or blowing the stars blind. Too weak of confinement will not give the stars a good spread. Ideally both plugs will give away at the same time, although it is common for only one plug to blow out. When this happens, the effect is actually not ruined, since one star emerges burning in one direction while the casing with one star stuck

inside travels in the opposite direction. The star actually burns inside the casing but is visible just as if it were correctly ejected.

The stars used for the scatter stars should have only very little clearance inside the casing. This insures that the stars will travel far and also prevents the central burst charge from migrating around the sides of the stars instead of remaining at the center where it needs to be. Pumped stars are the best choice for these, since they will travel farther than an equal sized round star. However, round stars are necessary for streamer to color effects, which make attractive scatter stars. Thus the break charge may be increased slightly over what is shown here when using round stars.

Figure 4: Drilling 7/32" time fuse holes at center of scatter star casing.

Because your comets and scatter star tubes may be different dimensions than shown here, it is important to trial fit all components before building this shell. Figure 3 shows how to make sure everything will fit by arranging the comets and inserts on the end disk used to build the shell (4-1/2" diameter in this case). Also stack your finished comets next to the scatter stars to figure out how many rows of comets you will need, as well as how long to make your shell casing. The comets used here are 3/4" diameter and 7/8" long. Thus the shell casing will be about 5-1/4" between the two inside end disks. Three rows of 10 scatter stars will require five rows of 14 comets in this case.

Figure 5: Determining maximum possible time fuse length.

First you will need to drill center holes in all your scatter star casings. For typical 1/4" Chinese time fuse, a 7/32" hole will make a snug fit. In order to prevent the inside of the casing from caving in when the drill bit punches through it, insert a snug fitting dowel rod in to the case when drilling, as seen in Figure 4.

Next you will want to determine your time fuse length, as seen in Figure 5. Nothing is worse than building a boat-load of tedious inserts only to find that their time fuse length prevents them all from fitting into the shell! Because of space limitations, you are really limited to about a two second maximum delay on the scatter stars. You can get around this limitation by using smaller comets, but 2 seconds is really a pretty good delay. Making the delay any shorter tends to lessen the scatter effect, since the stars will be firing closer and closer to the point where the shell broke instead of being able to drift out a good distance.

Figure 6: Scatter star components ready for assembly.

The time fuse is cut at a 45 degree angle for the end that will be inside the scatter star, while the other end is flush cut. The overall length used here is 1-1/8" end-to-end. You can cross match the time fuse, but the required offset from the end of the fuse will make your delay time shorter. Slurry priming the end of the fuse will give you the maximum delay possible, and is also faster than cross matching. It is better to create a ragged prime blob at the ends rather than a smooth one, since ragged surfaces take fire better.

Two methods are described here for making scatter stars. The difference between the two methods is in the way the end plugs are created. Both methods produce a good scatter star, but the second method using hot glue is considerably faster to construct.

Method 1:

First you will need some thin paper end disks that match the O.D. of your scatter star tube. I punched mine from chipboard using a hand held center-less punch. The disks are applied by dipping one end of the tube into a bowl of white glue, as seen in Figure 7, then applying the disk and allowing it to dry.

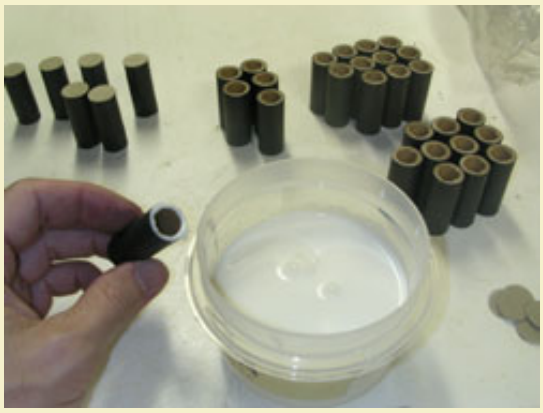

Figure 7: Dipping ends in glue bowl to fasten end disks.

Powdered clay is used as the filler at both ends of the tube. This not only has the purpose of filling the void, but it also serves to seal the end of the tube from possible gas leaks through holes in the glued seam. Fine sawdust can also be used in place of the powdered clay, but I find that the clay is easier to work with and makes a better seal. The amount of clay used is about 1/4 of a teaspoon.

Figure 8 shows a home-made scoop that is designed to allow easy loading of small tubes without the need for a funnel. This type of scoop comes in handy when loading a lot of tubes with small quantities of powder such as this. I originally saw this scoop design in a chemistry set I had as a kid, and had to rebuild it out of sheet aluminum after I lost the original scoop. It's one of those little things I just can't go without!

After loading the fire clay increment into each tube, tamp it down with a rammer (do not pound it with a mallet), dump out the excess dust and then insert one of the pumped stars. It is faster to do a single operation on all tubes instead of building each scatter star from start to finish. Thus, after all the stars are inserted in all 30 tubes, proceed to insert the time fuse into all the tubes.

Figure 8: Padding with powdered clay. Note home-made scoop for easy loading without funnel.

More...

5" Comet & Scatter Star Shell...

Figure 9: Adding center charge of 2Fg after inserting 1st star and time fuse.

Figure 10: Padding the remaining space with powdered clay prior to gluing on second end disk.

Once the time fuses are all inserted, use the scoop again to add 1/4 teaspoon of 2Fg black powder into each tube. The second star is then dropped on top of this, and the remaining cavity is filled with powdered clay. The clay is just pushed down tight with your fingers, there is no need to ram it. Figure 10 shows half of the tubes finished off with the powdered clay. Note the close fitting stars in the tubes without the clay. These are the 3/8" pumped stars made as described here and primed in the NASCAR star roller to about 1/2" O.D.

Once the clay is in place, dust off the excess clay on the rim of the tube and then dip it in the white glue as before in order to fasten the remaining end disk.

Lastly you will need to seal around the joint where the time fuse enters the case. I advise not to use white glue for doing this, as this type of glue often forms pin holes upon drying and these holes will cause the tubes to fire immediately when the shell bursts. If you must use white glue, apply one bead and then apply a second bead after the first one dries in order to reduce the pin hole problem. Otherwise just use hot melt glue to seal the joints without any worries, as seen in Figure 11.

At this point the scatter stars are useable (after you cross match or prime them of course). Pasting a 1-1/2" square of thin, recycled kraft over each end will add further gas leak prevention and also increase the distance the stars will travel when they fire.

Method 2

The second method of producing scatter stars is similar to the way M-80s are mass produced. Both ends are plugged with hot glue, and that's it. The fixture shown in Figure 12 is for loading a single tube, but what you really need is a larger piece of wood with about 20 of these nipples in an array. This would greatly increase productivity, otherwise a single nipple can be used to produce one scatter star at a time, with an annoying wait for the glue to dry before removing each single device. The nipples do not need to be the exact I.D. of the tubes that will be placed on them, but they do need to be exactly 3/16" tall.

A star is placed on the nipple, then tube with the time fuse already installed is placed over it and onto the nipple. The burst charge is now added into the tube and then the other star is placed on top. Hot melt glue is then poured right on top of the star until even with the edge of the tube, as seen in Figure 13. When the glue solidifies, the tube is removed and then the void at the other end is also filled with hot melt glue. If you were loading many tubes at once on a pin array

Figure 11: Sealing around time fuse with hot glue.

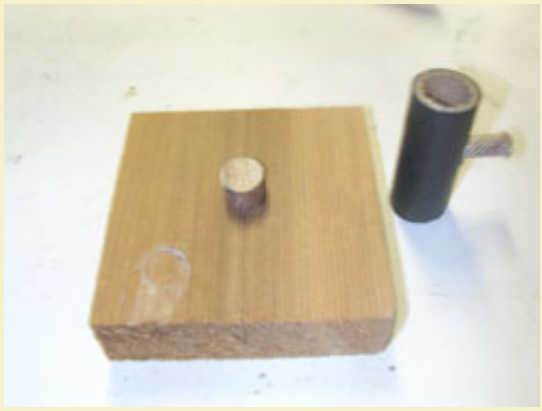

Figure 12: Loading fixture for the hot glue method.

Figure 13: Hot glue used to fill ends of tube.

Figure 14: Inserting the scatter stars.

as mentioned, you would need to place a board on top of all the tubes and invert them all at once. After they are inverted, remove the pin plate from on top of them and hopefully you won't knock any over in the process.

That's it, you're done. Of course you just burned through a lot of hot glue, but at least you are not still punching disks out of a piece of cardboard, which is where you would be at right now if you went with the first method.

Loading the Shell

This shell is finished exactly the same as described here, except the color pistil stars are replaced by the scatter stars. The scatter stars are stacked the same way comets are, with each new row offset from the previous row to form a "brick wall" pattern. As the referenced article shows, only one turn of chip board liner is used in order to allow all the comets to fit snugly. Also note that the shell is built "upside down," meaning that the time fuse and pipette is installed at the bottom of the shell casing before it is loaded.

Because the scatter stars take up so much space, it is a good idea to load the break charge on top of each row as they are installed. This allows some break charge to settle in the gaps behind the tubes. Be sure to bounce the shell to make sure the burst charge settles down past all the time fuses. It also helps to pad a little between rows of scatter stars with some burst charge, but the extra space consumed by the padding must be allowed for when you cut the shell liner. It is easier to load the scatter stars after every couple rows of comets have been installed, instead of installing all the comets first and then trying to fit your hand down into the small hole to insert the scatter stars.

Charcoal comets work very well with this shell, since they allow the colored stars to show up well in contrast. Another interesting effect would be color comets with silver flitter or glitter scatter stars that fill the center with bright streaks of random trajectories.

Another interesting effect would be to load the shell with nothing but scatter stars, replacing the outer comets with scatter stars and then inserting the second inner row of scatter stars as well. The extra space may allow a 2.5 sec delay on the time fuse, creating a dark break followed by a swarm of scatter stars. I haven't tried it myself, but it's definitely on the to-do list.