Build This...

5" Sun and Planets Shell

June, 2002 Issue

Build This:
5" Sun and Planets Shell

Design Notes:
Maltese Multi-break Shells

Tool Tip:
Build a Maltese Shell Rolling Tool

Technique:
Making Dragon Egg Microstars

Summary:
This shell is a variation of a "shell of shells" effect, where a single shell bursts into a ring of smaller shells which all break in a ring of small color splashes. The Sun and Planets effect is characterized by the simultaneous break of all the planets and a larger central color break (the sun). With precise timing and well made insert shells, this effect can be quite attractive in the sky.

Prerequisite: Insert Shells, 5" Comet Shell

Materials:

BREAK 1 (planets)

- (2) 4-1/2" dia end disks with 7/32" hole
- (2) 4-1/2" dia end disks with 1/2" hole
- (3) 7" x 24" long 70lb kraft strips, grain short
- (1) 4" x 14-1/2" long chipboard, grain short
- (7) 1-1/2" I.D. insert shells w/1" between cross match
- (1) piece of chinese time fuse w/1-1/4" between cross match
- (1) 3/8" ID x 2" long pipette
- (1) 5" piece of cross match
- (1) 1" piece of cross match

BREAK 2 (sun):

- (2) 4-1/2" dia end disks with 7/32" hole
- (2) 4-1/2" dia end disks with no hole
- (3) 8" x 24" long 70lb kraft strips, grain short
- (1) 5" x 29" long chipboard, grain short
- (1) piece of chinese time fuse w/1" between cross match
- (1) 3/8" ID x 2-1/2" long pipette
- (1) 3/8" ID x 1-1/2" long pipette
- (1) 6" piece of cross match

Tools:

- 4-1/2" dia. case former
- Rubber mallet
- 1-5/8" OD canulle (solid or hollow pipe)
- Cross match punch
- 7/32" and 1/2" drill bits
- Hot glue gun
- Scissors

- (1) 4" piece of cross match

Unmeasured Materials:

1/2" cut or round stars, strong twine that doesn't stretch, 2FA black powder, rough powder, sawdust, white glue, masking tape, tissue paper and wheat paste.

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Introduction:
The sun and planets shell is a classic Italian design that, while seldom seen in public shows, is a favorite among armature builders. The design is a variation of the shell of shells type effect, whereby a single shell breaks into a ring of smaller shells to create a circle of small breaks in the sky.

The key distinction between a sun and planets shell and a normal shell of shells is that the sun and planet shell begins with a dark break that throws the planet shells out in a ring and allows them to get far enough away so that when they break they will not overlap the larger color break of the "sun," which is the second break.

Figures 1 through 3 show some of the effects possible with the sun and planets shell. Figure 1 is suspected to be a regular shell of shells, since the center break appears to have broke first and is fading out as the planets break. Figures 2 and 3 show that the sun and planets all broke at the same time.


Figure 1: Blue planets with red sun.


Figure 2: Red planets with blue sun.


Figure 3: Willow planets with firefly sun.

Methods of Construction:
There are a few different ways to achieve the sun and planets effect. Figure 3 shows the simplest method, which is really a shell of shells and not a sun and planets shell, but the effect is similar. The insert shells and the color break are all loaded into the same break, making it a single break shell. The insert shells are thrown out at the same time the color break opens, thus there is a delay before the planets are seen. This method does not allow the shells to clear the span of the color break the way the two break method does.

Figure 4 is also technically a shell of shells, even though the inserts and color break have been packaged into two separate breaks. There is no time fuse between the breaks, only an empty tube that allows the fire to pass through and break both shells at once. Hence, there is only one detectable break in the sky, making this a single break method. The purpose of separating the inserts and stars into two separate breaks is to both increase the integrity of the shell and improve the symmetry of the color break. Analysis of shell breaks using video has revealed that putting the stars and the inserts into one long break can create a flat spot in the color break when seen from a side view. Longer compartments within shells are also more susceptible to side split and flower potting during lift than are shorter

compartments.

Figure 5 shows the technically correct method of making a true sun and planets shell. The shell is a two break shell in which the first break is the planets. The time fuse on the second break is identical in timing to the time fuses on each insert break. This way the sun will break at exactly the same time as the planets. Note that the planet break can be opened while the shell is still ascending and the relative velocity of all the planets will still keep themselves aligned around the second sun break as they all rise together.

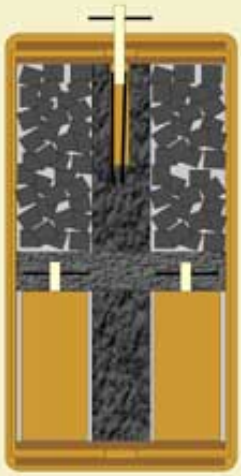

Figure 3: The single break method.

Figure 4: The single break compartmentalized method.

Figure 5: The two break method.

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Figure 7: Seven insert shells arranged in a ring.

Figure 8: Packing sawdust into the gaps between the shell wall and canulle.

Figure 9: Sawdust fully loaded and canulle is removed.

Constructing the Planet Break:
First prepare two 4-1/2" diameter end disks by drilling a 1/2" hole in the center. These will both be used for the bottom disks of the first break, which holds seven 1-1/2" insert shells. Since this is a multi-break shell, the hole in the bottom of the shell will allow the time fuse from the second break to enter into the first break.

Begin by rolling three sheets of 24" long by 7" wide kraft around the case former. One trick that makes it easier to slide the case off the former is to roll the sheets with a few inches overhanging the edge. This gives you something to grab onto when adjusting the case for placement of the end disk. Adjust the case so that 1-1/2" of paper extends beyond the end of the former and insert one of the disks with the 1/2" hole onto the end of the former. Proceed to pleat the paper over the disk, one layer at a time with white glue between each layer. Taking shortcuts here and just pleating all the layers down together can result in end plugs blowing out, risking a poor break.

Slide the case off the former and insert a single turn of chipboard measuring 4" wide by 14-1/2" long. Normally two turns of chipboard is used when building canister shells, but in this case the extra turn would prevent all seven insert shells from fitting inside. With one turn of chip, the inserts will fit very snugly with no need to shim between them.

Before loading the inserts, stick a piece of masking tape over the hole from either the inside or outside of the bottom disk. This is to prevent the break charge from leaking out until the two breaks are ready to be stuck together. Some builders will build the last break first and then place the unloaded first break on top of it during loading. I find that it is easier to fully load all breaks and then spike them together afterwards, especially where three or more breaks are required.

Figure 7 shows all the inserts loaded into the shell. Normally I find it easier to load canister shells upside down so that the time fuse is at the bottom of the can while it is being loaded, but this particular break requires that it be loaded from the bottom up. This is because the insert shells must sit firmly on the bottom of the shell with their time fuses pointed away from the lift charge. If the insert shells were oriented upside down, then setback forces from firing the shell could break the seal around the time fuses where they enter the inserts.

The 1-5/8" diameter canulle is wrapped with two turns of tissue and inserted into the core between the inserts, as seen in Figure 8. Sawdust is now packed between all the gaps around the inserts using a small rod to tamp it down. This sawdust helps hold the inserts in place and improves the symmetry of the break. Once the sawdust is packed level to the tops of the

Figure 10: 2FA is loaded into burst core, while rough powder is used to fill the remaining space above the insert shells.

inserts, the canulle is removed as shown in Figure 9.

The central burst cavity is now filled with 2FA until level with the top of the chipboard. The remainder of the space above the inserts is filled with rough powder until also level with the chipboard, as seen in Figure 10.

An end disk prepared with a time fuse measuring 1-1/2" between cross match holes is now used to close the shell. Go here for details on how to prepare the time fuse. The pipette used in this break will be 2" long, directing fire to the center of the shell as required for an optimized flame progression through the burst charge. It will be necessary to bounce the shell on the table in order to settle the time fuse into the 2FA core, especially if you are using unglazed homemade 2FA. The remaining paper is now pleated over the disk as before and a second end disk is glued on each end of the shell (note that the second bottom disk must also have the 1/2" hole).

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Figure 11: The second break is vertically spiked before attaching the first break.

Figure 12: The second break is inserted upside down into the hole in the bottom of the first break.

Assembly and Spiking:
The second break is a standard five inch color break that measures five inches in height (see materials list under Break 2 for other dimensions). The time fuse for this break is the same as the time fuses used on the insert shells in the first break (1" between cross match holes in this case).

After loading and closing the second break, a four inch piece of cross match is inserted into the time fuse, then a 1-1/2" long sleeve is glued around it in the same way that pipettes inside the shell are created. This pipe is made with 3 turns of 70lb kraft around a 3/8" former. The purpose of this tube is to provide a rigid sleeve around the time fuse so that it can be easily inserted into the bottom of the first break. The cross match should extend beyond the top of the pipe to help insure ignition.

The second break is now spiked in the vertical direction only, preferably using the offset method to help keep the string flat on top so the two breaks will not have a pile of string between them. Figure 11 shows the two breaks ready to be attached.

Puncture the piece of tape over the passfire hole on the bottom of the first break and invert the shell onto a fixture that protects the time fuse, as seen in Figure 12. The second break is now inserted into the first break, which may require some bouncing on the table to get the time fuse pipe to settle into the break charge.

The two shells are now bound together by vertically spiking the first break onto the second break, as seen in Figure 13. This may seem a little tricky at first, since it is important to keep the two breaks pressed firmly together while applying the first several loops of twine. The twine should be applied as tight as possible so that there is very little space between the two breaks. If the first couple passes of twine are not applied tight enough in the beginning, then the later loops of twine will pull the shells closer together and cause the first few strands to become loose.

Once all the vertical spiking is applied, the twine is run down to the bottom of the shell to begin the horizontal spiking. The spacing of the horizontal spiking on the bottom break is close together as for a normal shell. The general rule for spiking is that the squares created by the crossing twine should be about the same size as the stars you are using.

Once the bottom break is fully spiked, the twine is tightly wrapped several times around the shell at the point where both breaks come together. The twine should completely cover the area between the two breaks, which helps to fireproof the gap and also pulls the vertical spiking tighter. See Figure 14 for the full spiking pattern required for the shell. Note that the spiking is much

Figure 13: The first break is now vertically spiked onto the second break.

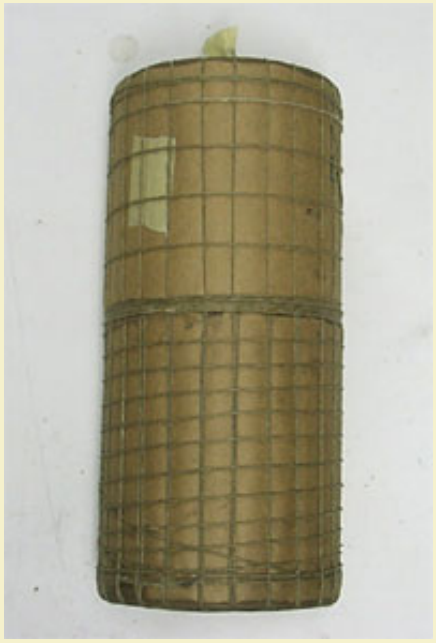

Figure 14: Horizontal spiking is applied to both breaks. Note the denser spiking for the color break compared with the insert break. Also note the tight grouping of twine at the junction between the two breaks.

wider on the top break, due to the fact that it contains insert shells instead of stars.

With the spiking complete, the shell is pasted in with three 24" long strips of 70lb kraft. The width of the strips can be determined by using a thin strip of paper as a tape measure to gauge the distance from the base of the time fuse, down the side of the shell and then slightly past the center point on the bottom of the shell. For more information about pasting in canister shells, go here.

The shell is finally lifted and leadered as explained here.

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