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The Poor Man's 3/4" Comet Plate

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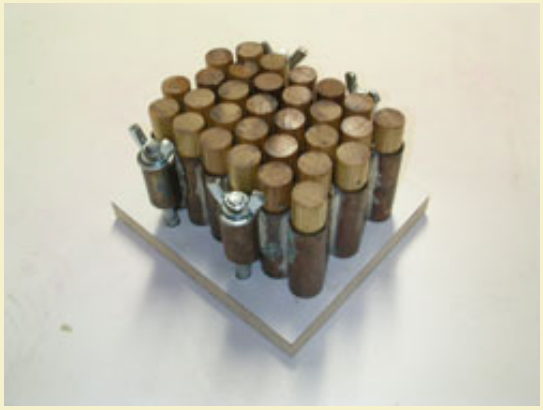

Materials:

- (30) 2-1/2" long 3/4" copper tubes
- (4) 1-1/2" long 3/4" copper tubes
- (30) 3-1/4" long 3/4" oak dowel rods
- (30) small 1/2" long nails or tacks
- (4) 4" long 3/8" bolts
- (4) 3/8" wing nuts
- (4) 7/8" O.D. washers
- (1) 7" x 6" scrap of 3/4" plywood
- (1) 8" x 8" scrap of Formica
- Solder
- Flux
- Polyurethane

Figure 1: Brushing flux onto a pipe segment before soldering.

Introduction

Anyone who has ever built a large multi-break Maltese or Italian shell can attest that at least half of the construction time was spent painstakingly pumping out comets one at a time. It takes about 342 3/4" comets to make one three break six inch multi-break shell, and pumping these out one at a time takes over three hours of tedious monotony.

Comet plates are simply large caliber star plates that allow multiple comets to be produced in one operation. However, the larger size requires thicker blocks of metal and longer drilling times to produce, thus a typical 3/4" star plate costs several hundred dollars if purchased from a pyro tool supplier.

Figure 2: Squaring up a row of tubes to be

Some pyros who are handy with machine tools and have lathes and milling machines at their disposal have produced their own comet plates, but even with the right tools on hand it is not a trivial task. Traditional comet plates use large blocks of aluminum as the hole plate, with many pins that must be machined on a lathe and then fastened to another thick plate using set screws for each pin. The pin holes must be drilled and then bored out with a special bit to insure that the walls are smooth so that the comets can slide out easily.

Most pyros can not afford a commercial comet plate and do not have the means to build their own. When pressing dozens of large comets at one time, even having the proper plate set is not enough. You must have a hydraulic press to adequately compress many large comets at one time, and you also need some type of holding fixture so that the comets can be pressed out using the press ram once they have been consolidated. Needless to say, the setup for producing

soldered together.

Figure 3: Using a blowtorch to run a bead of solder between each pipe.

Figure 4: Soldering the shorter clamping tubes to the sides.

Figure 5: The finished tube block for pumping 30 comets.

large volumes of comets is out of reach for most pyros.

The project shown here is a poor man's comet plate that can be easily made by most anyone. The parts are available in almost any hardware store, and the whole thing can be built for under $30. No special machinist skills are required and it can be fabricated using only hand tools, although a cut-off saw makes the task of cutting all the tubes and dowel rods to the same size a lot easier and faster.

The plate design uses commonly available copper plumbing pipe to provide the pressing sleeves, thus removing the need for drilling large holes in thick, expensive blocks of metal altogether. The use of thin walled pipe soldered together into a block also produces a denser grouping of holes than could be produced by drilling, so the resulting hole plate is more compact and easier to fill with composition.

The user of copper tubes also allows you to have exact control over the thickness of your hole plate. You can run experiments with various lengths of tubes to see what heights the compositions you plan to pump will compress into. This way you can make a plate that produces stars of the exact height that you want. Those who build traditional star plates are limited by whatever blocks of aluminum they happen to find at the scrap yard, and the thicker chunks of metal are more difficult to find (not to mention expensive).

The pin plate is not a plate at all, rather just a bunch of loose pins inserted into the holes. This simplifies construction by removing the difficulty of aligning many pins with many holes, and also removes the chore of securely fastening many pins to a pin plate. Another benefit to this simplicity is that the pins can be made from whatever material you can find that will withstand medium blows from a hard rubber mallet. Commonly available oak dowel rods were found to sufficiently fit inside the copper tubing and hold up quite well to pounding.

The independent pin design featured here also allows the comets to be consolidated by hand ramming, which is not possible with a traditional plate of the same size. Because the pins are not all attached to a common pin plate, a mallet can be used to apply force to each pin independently. A traditional comet plate, where all the pins are connected to a common top plate, will take any force applied to the top plate and distribute it equally to all pins. This makes hand ramming a large caliber comet plate ineffective and a hydraulic press is required. The plate shown here allows all the force from a small rubber mallet to strike just one or two pins at a time, thus each comet gets the full brunt of the ramming force. As the comets are pressed, those that are compressed less than others will have their pins sticking up higher, thus the mallet will hit them first until they are level with the others. This feature insures that the comets in most need of compression get the most impact from each blow, until such point that all pins are rammed evenly.

This comet plate also works equally well when used with a hydraulic press. Simply place a thick block of scrap metal on top of all the pins to serve as a pressing plate, then insert it into your press and compress all pins at once the same way you would with a traditional

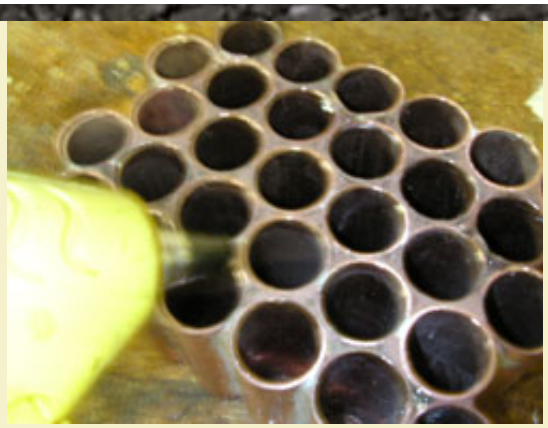

Figure 6: Using hot glue to fill in the voids between pipes.

Figure 7: Shaving the solidified glue flush with the surface.

comet plate.

Another advantage of this independent pin design is that the comets can be pressed out of the bottom plate without the need for a hydraulic press or heavy blows from a mallet. When pressed individually with your fingers, the comets will slide right out! Simply hold the filled plate by the finger holds on the sides while rapidly pressing the comets out one at a time by pushing the pins down with your thumbs.

The only disadvantage with the independent pin design is that it is slower to setup than a traditional plate, since you have to place the pins into the holes one at a time rather than just positioning a single plate on top that inserts all the pins at once. Ditto for removing the pins after the comets have been pressed out. So it's a little slower than a traditional plate to operate, but still markedly faster than pumping single comets out one at a time and a lot easier to build and operate for the average pyro on a tight budget.

More...

The Poor Man's 3/4" Comet Plate...

Figure 8: Cleaning up the edges of an oak dowel rod.

Figure 9: Using a jig to consistently mark the nail position on all pins.

Making the Hole Plate:
The plate shown here is designed to pump 30 comets in five rows of six tubes per row. This is a somewhat arbitrary number and you can easily change it to whatever size array that you want. You can even add onto the capacity at a later date by simply soldering on more rows of tubes and making more pins.

The copper pipe being used here is common 3/4" plumbing pipe available at almost any hardware store. The I.D. is slightly larger than 3/4", but it is close enough to work well. The tube length shown here is 2-1/2" long, but you should experiment with the compositions you plan to use most often for comets before committing to a tube length. I used metallic KP formulas heavy in parlon for my own trials, with a resulting star height of about 3/4".

The trials are conducted by dampening the comp, running it through window screen and then filling the tube with loose grains until it is full. Do not compress the comp into the tube with your fingers, just loosely fill it the way you will be doing when you use the plate. Then hand ram a single pin with a mallet and measure the height of the resulting comet. If it is too short then try a longer tube, or if it is too tall then try a shorter tube.

Once you determine your tube height, you will need to cut 30 tubes to that length. This can be pretty tedious without a cut-off saw, also known as a horizontal band saw. This is probably one of the most useful power tools for the pyro hobbyist that there is, so if you haven't looked into getting one yet I would seriously recommend one. It's going to save you from making 60 cuts in just this project alone!

Once the tubes are all cut, de-burr the inside edges with a de-burring hand tool and then clean up the outside edges with sandpaper or, even better, using a power sander or bench mounted grinder. Make sure the outside of each tube is free from grease and debris before proceeding.

You will be soldering these tubes together in groups of six using a blowtorch and plumbers solder. You will also need to obtain some soldering flux, which is a grey paste that is brushed onto the areas to be soldered as seen in Figure 1.

Build a temporary fixture for holding six tubes together as seen in Figure 2, with a block of wood used to butt all the ends against so they are level. Brush the flux on the tube walls at the point where they touch each other. The tubes will get very hot, so make sure the

Figure 10: Driving a small nail to be used as a depth stop.

Figure 11: Nail prevents pins from falling all the way through the tube when comets are pressed out.

Figure 12: Dipping the pins in polyurethane for water resistance.

surface you are working on will not get damaged by heat. The table top shown in Figure 2 is a 1/2" thick piece of cement backer board.

A blowtorch is now used to "sweat" a bead of solder between the joints of each tube, as seen in Figure 3. The solder goes through two phases before the job is done, so be careful not to remove the heat prematurely. At first the solder will melt, but still bead up on the surface and not adhere to the metal. Continue applying heat until the surface tension of the solder breaks down and flows smoothly into place.

Once the joints are soldered, wait a few minutes until they solidify, then use BBQ tongs to dunk the hot metal into a bucket of water. This process is repeated four more time so that you have five separate rows of tubes.

Once the five rows are completed, they are stacked together and clamped using metal bar clamps. This assembly is then turned on its side and a bead of solder is used to connect the outside edges together. There is no way to solder the inside joints, so be sure that you do a good job on the outside joints. Once finished, dunk the unit in water again to cool it off.

Next you will need to attach four shorter pieces of pipe to the long sides, which will be used as both finger holds when ejecting stars and for clamping the fixture down to an optional hold-down plate. Rest the block of tubes on its side and attach the shorter tubes with a bead of on each side as seen in Figure 4. The completed tube assembly is shown in Figure 5.

If the tubes are not all even on both the top and bottom of your hole plate, use a sanding block to work down the high spots and level it out.

The voids between the tubes are now filled with hot glue, as seen in Figure 6. If these voids are not filled, powder will fall into the cracks and make a mess during use, so you really should plug the holes. The gaps on both the top and bottom sides should be filled. It helps to pre-heat the copper block with your torch prior to applying the glue, which helps the glue settle into the crevices rather than beading up on contact. Once all the cracks are filled with glue, dump the unit into a bucket of water so that the glue will solidify quickly.

Once the glue is hardened, shave off the excess using a thin knife as seen in Figure 7. This should give you a smooth surface that is free of pinholes and gaps. If you missed some spots, just reheat the area with a torch, apply more glue and then trim it again. Be sure to clean up any glue that leaked down into the tubes.

Making the Pins:
A pin that is about one inch longer than the tube length needs to be made for each hole in the plate. You can use wood, metal, plastic or anything that can take a beating. I'm using oak dowel rods here because they are cheap and easy to find.

After the pins are cut, sand the top and bottoms smooth and de-burr

the edges. A small nail is driven nearly all the way into one end of the pin as seen in Figure 11, which is to prevent the pins from dropping all the way through the plate when the comets are ejected. The nail should be located about 1/4" above the top of the tube when the pin is inserted, which will allow the pin to project out the bottom of the plate by 1/4" after the comet is pressed out.

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Figure 13: Drying the pins on a sheet of newspaper.

The Poor Man's 3/4" Comet Plate...

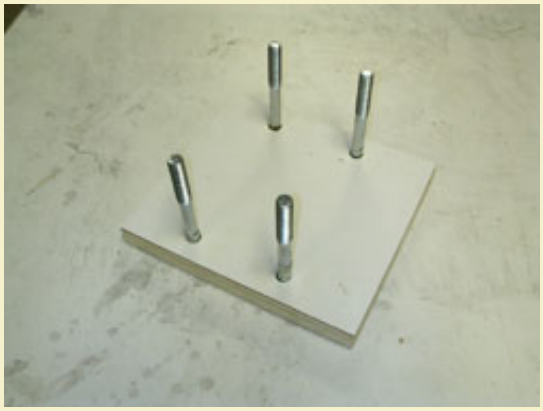

Figure 14: Building the optional hold-down plate.

Figure 15: Bolt heads are counter-sunk into bottom of plywood.

Figure 16: Hole plate fastened to the hold-down plate.

Because there are 30 nails that have to be positioned, it helps to create a jig for marking the nail positions. Figure 9 shows how a drill press with some blocks clamped to the drill stand can be used to mark the nail positions. A center punch is chucked up in the drill while the boards hold the pin in the desired position so that all pins will be marked in the exact same spot.

When using wooden pins, you'll need to coat them with a moisture barrier so that they will not absorb water and chemicals into the grain. Since the pins will be subjected to water when cleaning after each use, you need to use something that can hold up to water at least on a short term basis. I'm using polyurethane here, which is easy to apply by simply dunking each pin into a container of urethane as seen in Figure 12. Each pin is fully submerged into the urethane and then placed on a sheet of newspaper to dry. This process should be repeated at least two times in order to get a good coating.

Hold-Down Fixture:

At this point your comet plate is completed and ready to use. However, you may wish to make the optional hold-down fixture seen in Figure 14. Certain types of composition, such as those heavy in parlon and metal dust, require a good deal of moisture before they can be used to produce comets without crumbling. This overly wet type of composition tends to ooze out the bottom of the plate during ramming and will actually spread out under the plate such that it lifts it right off the working surface. The hole plate literally begins to rise up on top of a bedding of composition that squeezes out the bottom as it is being rammed, resulting in inconsistent comet sizing and a big mess that has to be shaved off the bottom before ejecting the comets.

The hold-down fixture eliminates this problem by firmly securing the hole plate to the working surface. If you will be using a hydraulic press to pump your comets, then the hold-down fixture is highly recommended regardless of the type of composition being pumped. While it does add an extra setup step, the hold-down plate insures that overly viscous compositions or bouncing during hand ramming does not result in composition working its way out the bottom of the tubes.

The hold-down fixture uses four bolts to tightly secure the hole plate to a piece of wood that it will be rammed against. The bolts run through the four finger holds that were soldered to the sides of the hole plate, as seen in Figure 16. A washer and wing-nut is used to cap each bolt and fasten down the hole plate. The wing nut tends to get in the way of the pins however, so you may choose to use just a

Figure 17: Completed components of the comet pressing tool.

Figure 18: Using a hard rubber mallet to prevent damage to wooden pins.

Figure 19: Individual pins allow comets to be pressed out by hand.

regular nut instead and keep a nut driver on hand when working.

The base of the hold-down fixture is a scrap of 3/4" thick plywood with a sheet of Formica glued to the working surface so that it can be easily cleaned. The bolt heads are counter-sunk into the bottom of the plate, making sure that the heads do not protrude above the surface of the plywood. I used hot glue around the bolt heads to help keep them in place, since I was unable to find long bolts that were threaded all the way up to the heads. If you can find fully threaded bolts, a nut could be used on the other side to fasten the bolts securely in place.

Usage:
This type of comet pump requires the composition to be granulated through a window screen and then loosely filled into the holes. The composition should not be overly damp such that it clumps together after screening, since it needs to free flow into the hole plate. The composition Is not pressed into the tubes in any way, it is simply spread across the surface of the hole plate and allowed to drop in. Any excess is scrapped off the surface with a thin blade and reused in the next pressing. This method of loading is not only faster than pressing composition in by hand, it more reliably deposits the same amount of composition in each tube.

Once loaded, each pin is pressed into place and then rammed with a rubber mallet as seen in Figure 18. The mallet should be the hard rubber or plastic type, as a soft rubber mallet will not compress the comets enough. A brass hammer could also be used if you are careful about controlling how hard you hit the pins and be careful to avoid glancing blows off the sides of the pins.

Once all the pins have been rammed down to the same level, the comets are ready to be ejected. Check the bottom of the hole plate and make sure there is no excess composition that needs to be shaved off. Failing to shave away excess composition can result in inconsistent comet sizes and sloppy edges.

Traditional comet plates are placed on a stand-off fixture similar to Figure 20 when the comets are being ejected. The plate fits down between the two side walls such that the bottom of the hole plate is held about an inch above the surface.

Since this comet plate features individual pins, you can easily pump the comets out one at a time while holding the plate above your catch pan, as seen in Figure 19. Normally you would hold the plate with both hands and use both thumbs to rapidly eject the comets one by one. The smooth copper tubing really releases the comets quite easily.

Figure 21 shows how the comet plate can be used with the home made press described here. The only extra thing you need is a thick block of metal to place between the pin heads and the bottom of the bottle jack. The hand-rammed comets are still tough enough that they can't be broken in half by hand when dry. However, hydraulically pressed comets are even more durable and, because they are denser, will burn slightly longer than hand rammed comets.

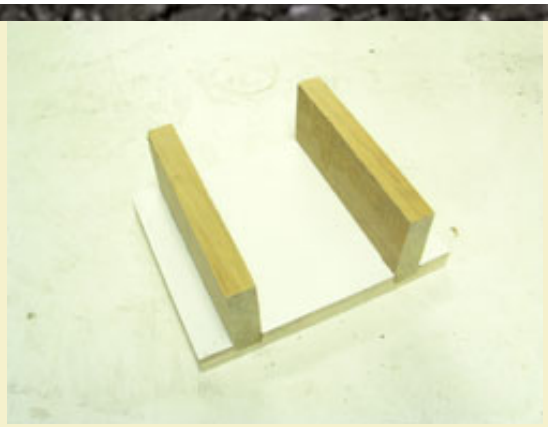

Figure 20: Optional pressing stand-off fixture.

Figure 21: Using the comet plate in a home-made press for creating rock-hard comets.

A little time and effort invested in building this tool will easily pay for itself in saved time and drudgery after only a few large multi-break projects. The low construction cost and ease of fabrication really brings efficient comet pressing to the masses!