

PMC Conference Presentation  
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COLD CONNECTIONS:  
Or how to love PMC without having to carry a torch for it

Introduction

The Scene: You are at your bench. You have an old potshard and you want to set this on top of a piece of standard PMC you have textured with a seashell. You then want to perch that "unit" on a flat rectangle of driftwood. You also want to attach 7 small PMC starfish you made in PMC+ to the wood around the standard PMC unit. Then you want a PMC frame around the whole wooden rectangle. Finally, you want to hang the entire piece from a PMC 3 bail attached to the wood so that the bail can twist on the wood as the piece dangles from it's chain.

You think for a moment ..... NO PROBLEM!!! You know about cold connections and that knowledge will allow you to attach just about anything, to just about anything else - without the use of heat or (most of the time) a chemical bond (we don't use the "G" word).

**Cold connections**, those made without the use of a torch, allow the artist to attach fired PMC to other materials as well as to other pieces of fired PMC. These attachments can add greatly to the strength, durability, and expressive possibilities of a piece. There are numerous types of cold connections and within each type there are countless variations and combinations. In my presentation I will be showing several types or categories including: rivets, prongs or tabs, folds and micro fasteners. Within each category I will demonstrate 1 or 2 variations. The first category, **riveting**, is actually much like hammering 2 boards together with a nail that has a head. When the nail is hammered through the 2 boards, the head stops the nail from going through the nail hole. Then, when the nail (rivet) protrudes through the back of the second board, another nail head is formed thus trapping the 2 boards between the nail heads. If instead of using a nail, a hole is drilled and a wire inserted, the ends of the wire can be hammered to form a head, on the front and the back, serving to trap the pieces and attach them to each other.

The next category is **tabs or prongs**. These may be thought of as small "fingers" that protrude out from the edge of a flat piece of PMC and are bent up and partially wrap around another piece placed atop the flat PMC. The tabs hold the pieces together and are placed such that the piece being attached can't slip out. Alternately, a flat piece of another material can serve as the background or holding piece and the tabs could hold a piece of fired PMC.

Folds are similar to tabs but are longer in length and are particularly useful when trying to hold a piece in a box form. Consider taking a round cabochon and making a shallow, square box that just fits around the outside of the stone. One can take the walls of the box and lean them in slightly on all four sides and the stone will be held in place. The sides could also be bent in until they are pressed

against the object to be held and smoothed down, much like a bezel setting. **Micro-fasteners**, the last category, are simply very small nuts and bolts. They are available in several sizes and I use those that are equal to 14-gauge wire. Different pieces can be drilled together or separately and the bolt passed through the holes and then secured with a nut on the other end. The bolt can also be attached by putting a small ball of wet PMC onto another piece of PMC (fired or unfired) and pressing the bolt head into the wet clay. When fired, the bolt will be anchored in the clay and then passed through a hole in another piece and attached with a nut. The head of the bolt may also be cut off and the end of the bolt heated to ball the end for a decorative effect.

In addition to mechanical connections, I will also be speaking about chemical bonding using various glues, epoxies, and putties. Though rarely used as the *only* method of attachment, these adhesives can be useful in augmenting a connection or as a seat for an odd shaped element.

### **RIVETS: or two heads are better than one!**

If you have ever worn a pair of Levi's jeans, traveled on an airplane, or laced up a pair of Keds sneakers, you have had a riveting experience. For indeed, all these items have rivets, of one kind or another, as an integral part of their design. In addition to being a strong and versatile method of cold connection, riveting also has almost infinite decorative possibilities for the PMC artist. Riveting allows one to use PMC in conjunction with just about any material in almost any situation. It's a fast and easy method of adding smaller pieces of fired PMC, to larger pieces of fired PMC. It also permits the use of very thin sheets of PMC by riveting them to other materials for reinforcement. The tools are few (and friendly), the cost low, and the procedure fast.

Traditionally, a rivet is partially formed before inserting it into the work. Along with this method, I will demonstrate forming the entire rivet while in the piece. Makers may employ both methods depending on the situation in particular pieces.

If your pieces are to be joined with more than one rivet, it is very important to complete the first rivet before beginning the next, or your pieces will never line up.

In advance of riveting, it is a good idea to first anneal the rivet wire to make it more malleable. This is easily done by heating the wire until it just begins to show a dull red/orange color; lowering the lights a bit can help you see this. One can use any type of torch including the small butane type we use for other PMC work. Even heating over a stovetop burner will work in a pinch.

Since it is essential for the rivet hole and rivet wire to be the same size, a B&S gauge is a good investment.

I would encourage you to try several "practice" rivets before going on to your PMC and other finished work. When riveting PMC it is important to keep in mind that the PMC is relatively "soft" and the holes can be enlarged, (not a good thing) just by wiggling the wire in them.

A quick checklist for riveting is:

- Drill slowly
- Anneal wire before making rivet
- Do only one rivet at a time
- Drill on a wooden block
- Hammer on a metal block
- Hold work firmly when drilling

The following instructions are for riveting two or more pieces together.

### **Instructions**

- 1) Cut a 1" piece of wire and select a drill bit of the same gauge (check with a B&S gauge to ensure a match). File one end of the wire flat and square.
- 2) Using the awl, make an indentation mark in the top piece where you will drill for the rivet. Don't hammer with a nail or such as this may deform the metal.
- 3) Working on a wooden surface, position the pieces, as they will be when riveted. Seat the drill on the mark and slowly drill through all the pieces keeping the drill turning as you retract it from the piece. Alternately, you can drill through the top piece by itself, and position it to use as a guide for drilling the rest. It is important here to remember to NOT be tempted to drill any subsequent holes before completing this first rivet.
- 4) Insert the filed end of the wire from the back through the piece to connect all the elements. Since a tight fit is desirable, it may be necessary to twist (not wiggle) the wire to get it into the hole. Exercise caution here so as not to enlarge the hole. Grasping the wire with smooth-faced pliers will help. Allow about 1/2mm of wire (about 2 playing cards) to protrude on top. Cut the wire in the back so that about 1mm of wire remains and file flat and square to about 1/2 mm. You may need to hold a finger over the wire in the front to keep the protruding end in place. Check to see that you have about 1/2mm protruding on each side.

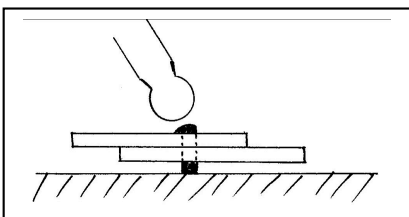


figure1

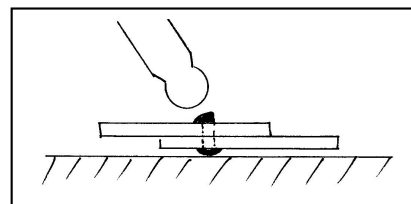


figure 2

- 5) Position the piece over a metal block and raise the piece up about 1/2 mm (figure1), in order to maintain the 1/2mm of rivet for the backside.

Playing cards placed on either side of the rivet may facilitate this. Using a round-faced hammer, strike the rivet wire around its edges with light blows to start forming a mushroom-shaped head. Turn the piece over and repeat for the other end of the rivet (figure 2). There is no need to hold the piece up an longer. Check to see that you have similar size heads and repeat hammering to finish forming a slightly domed head on each side. Try not to hammer in the center of the rivet or to flatten the rivet, as this will serve to weaken the rivet and resulting join. Placing a thin piece of leather on the metal block before forming the second head will help keep the first rivet head from getting a flat spot.

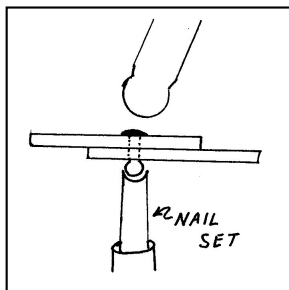
### **Alternate Method # 1 (traditional)**

- 1) Follow steps 1-3 above.
- 2) Holding the wire in a protected vice or smooth pliers, form a head on one end of the wire as in step 5.
- 3) Insert from the front and form rivet head on the other end of the wire.

### **Alternate method #2**

- 1) Ball the end of a 1" piece of wire (16 and 18 ga. work best for this method). To form a ball, hold the wire vertically and with a pointed flame, heat the wire about 1/4" up from the bottom end until it turns molten and "beads" up and forms a small ball. Immediately remove the flame, quench and pickle.
- 2) Proceed with drilling as above. For this method, insert the wire so that the ball will show wherever you want it. Cut and file the other end square.

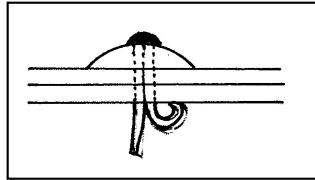
figure 3



- 3) Rest the balled rivet head on the metal block and rivet the other end of the wire. This will result in the ball getting a flat spot where it rests against the metal block. You may or may not like this look. To keep the ball round, clamp a nail set in a vice with the pointed end up. Sit the ball in the cup of the point and form the rivet head on the other end of the wire (figure 3). Different size nail sets have different size points; use the one that will yield the desired result.

## VARIATIONS

figure 4



Two variations on the simple rivet begin with half round wire instead of standard round wire. For the first, cut a piece about a 1" long and fold it in half so the flat sides are together. This will form a round wire, which is split in half in its length. Proceed as in alternate method #1 above, but instead of hammering the second head, spread the two halves of the rivet wire apart, thus trapping the two pieces in between the head on one side and the splayed legs on the other. If the legs are left longer, they may be bent into decorative spirals or other designs using a round-nose plier (figure 4).

For the second variation, cut a piece of half-round wire a little longer than twice the distance it will pass through. Put a small bead of wet PMC on the back of a fired or unfired piece of PMC and insert the folded end of the bent half-round wire into the wet clay. Fire as usual, drill a hole where the "rivet" will go, insert and splay as above.

Both of these variations are good ways of putting two halves of a lentil bead together or sandwiching just about any material in between the PMC piece and a backing piece.

### **TABS/PRONGS: or a cold connection that will really grab you!**

Picture this: hold your right hand out in front of you with the palm up and fingers stretched out flat. Place your favorite CD on the palm and curl the ends of your fingers up to take hold of the CD. You have just "tab set" the CD onto your hand. Now however, slowly start to squeeze your fingers together toward the center of your hand. Either your thumb is holding the CD from slipping out or you had to move your thumb to prevent this from happening. Either way, you just learned that the position of the tabs/prongs (from now on I will use only tab unless otherwise noted) is all-important to a successful use of tabs.

Now consider that instead of *your* hand, you have a bear paw and the CD is held in place by the pointed, sharp, hooked claws coming up around it. Or perhaps you're a Martian and you have 9 fingers, or 3, or 21. Now..... put your pinky finger up through the hole in the CD and bend the end of your pinky over to trap the CD. You have once again tab set the CD. This time however, it is held from the inside rather than from its perimeter. Be a Martian again, with many fingers that are really thin so that you can fit several fingers up through the hole and bend them all thus trapping the CD with multiple tabs. The idea here is that you have tremendous latitude in the number and placement of the tabs and that they

can be used to enhance the design or narrative statement you are trying to make in your work.

Below I will explain how to form a basic tab to hold from around the outside of a piece, another to hold from the inside, and some variations on each. Do keep in mind that these are the basics and you can vary all the aspects of the tabs to suit the needs of the piece and your personal expression.

Note: I will be using copper and silver in the photos, however, any metal may be employed.

### **Basic Outside Tab**

- 1) On a piece of paper, trace around the object to be set or if you will be firing PMC for the background, trace and enlarge by the % of shrinkage for that clay.
- 2) Plan the placement of the tabs so that when bent up around the piece, it won't be able to slip out in any direction (remember your fingers and the CD?). Add the tabs to the drawing (figure 5). Cut out the paper model and try it on the piece to ensure a good fit. You will probably notice that the tabs will need to be a bit longer than anticipated. Remember - the tabs need not be rectangular in shape.
- 3) Transfer the tracing onto the background piece and cut out or roll and texture the PMC and cut out the tracing. If using PMC, fire as usual, and finish as desired.

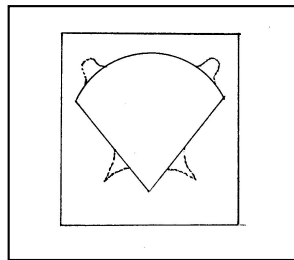


figure 5

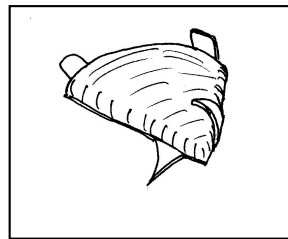


figure 6

- 4) Using a pair of pliers or your fingers, bend the tabs upward, not quite perpendicular to the surface of the background piece. Place the object to be mounted on top of the finished background piece and bend the tabs down against the object, pushing them with a piece of wood or plastic (figure 6). It is important to get the tabs down in one operation. That is, don't bend them down part way and then try and straighten them or the tabs will become work-hardened and will never sit flat against the object.

A variation on this type of tab (sometimes called a pop-up prong) is formed by tracing around an object, let's say a round piece of fired PMC, onto a background piece, like a rectangle of copper. Then trace a circle inside the first and about 1/8" smaller. Then draw at least three "spokes" about 1/8" wide starting at the outside circle and going in toward the center of the circles (figure 7). Now cut out

along the inside circle going around the spokes that protrude into the center. After the center section is cut out, cut along the edge of each spoke stopping at the outside circle. Bend up the spokes and file and sand as needed (figure 8). You will now have a ledge of about 1/8" inside the larger circle, with a space where the spokes have been bent up. Place the PMC piece on the ledge and bend the tabs (spokes) down against the piece as above (figure 9).

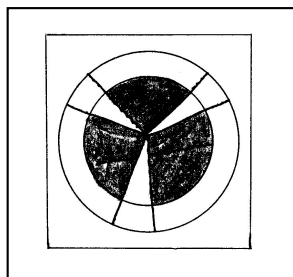


figure 7

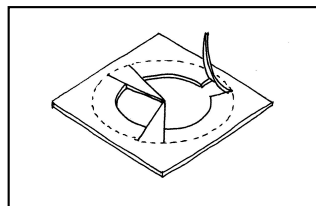


figure 8

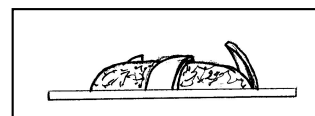


figure 9

### **Basic Inside Tab**

Note: this method is used only when the object to be set has an interior space. Donuts and window frame forms are examples of this type of object. There is also a limit to how small the interior space can be to allow the tabs to be bent up at the end of the process. Interior spaces of less than 3/8" are difficult if not impossible with this method.

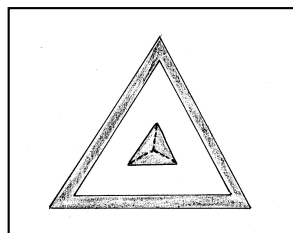


figure 10

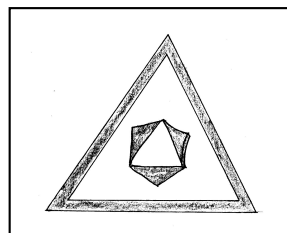


figure 11

- 1) Place the piece to be set on a scrap of paper and trace both the inside and outside shape.
- 2) Find the center of the interior space and mark it. Draw lines from the center to the inside line (figure 10). You will need at least 3 or 4 lines to define the shapes of the tabs that will be folded upward later. With a craft knife, cut along these lines from the center point out to the inner line but do not cut along the interior line.
- 3) Place the object to be set on the paper cutout and fold the inner tabs up to check your tabs.
- 4) Place your paper model on the background piece and trace all lines onto the background piece. Drill a hole at the center point, insert the blade of a jewelers saw and saw the tab lines from the center to the inner line but don't cut along the inner line.
- 5) Bend the inside tabs up just a little less than perpendicular to allow access and finish all edges.

- 6) Place the object to be set on top of the background piece and bend the tabs over the inside of the object and press down with a piece of wood or plastic (figure 11).

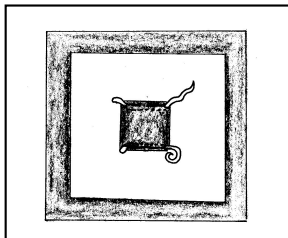


figure 12

A variation of this technique can be made by marking the inside shape of the object to be set, as above. Then make marks around the inside of the inner shape in sets of 2s. If the inner shape is a rectangle, you could make marks just inside the four corners: if it's a circle, you could make marks at 12 and 6 o'clock and 3 and 9. The next step is to drill holes at the marks making sure that the entire hole is just on the inside of the inner line. With a wire of the same gauge as the hole you drilled, make two "staples" whose legs will fit up through the holes in the background, and be long enough to bend over the object to be set. Finish the wires, insert them up through the holes, and trim them to the length you want, finish the ends and bend them down to hold the object in place (figure 12). Of course, the wires can be made any length or any color and could be twisted, curled or any manner of alteration. Additionally, a piece could be set by using both the inside and outside tab technique or any combination of the two.

### **FOLDS: or how to get pushy with your PMC**

A fold, cold connection, at least the way I'm considering it, could just as well be thought of as a tilt setting or if taken to its farthest extreme, a sort of bezel setting.

Let's go back to the CD in the tab example. This time however, think of putting the CD into it's plastic, case. Now remove the top part of the case so that the CD is in the bottom of the topless, shallow box and the edges of the CD just touch the sides of the box on all four sides. Now pretend the sides of the box become malleable so that you can tilt the top of each side in slightly at the middle of each side. If the sides then stiffened, the CD would be trapped in the box. This is what I call a fold setting and is similar to a box bezel with the exception that the wall (or bezel) isn't necessarily pushed down against the object to be set. These settings are fast, easy and can be used for just about any shape or sized object, however it lends itself best to setting objects with a flat back. (For objects with other than a flat back see the variation at the end of this section). When working in PMC, the "box" that will form the setting can be placed anywhere on the surface of the piece and the entire piece fired all at once. This method can be useful when trying to set a cabochon or similar object onto the top of a curved

surface such as a lentil bead. I will talk about this as a variation at the end of this section. The instructions for the basic fold setting are as follows:

- 1) Trace the object to be set onto a piece of paper and enlarge it to the appropriate size to plan for shrinkage.
- 2) Draw lines around the object to indicate where the “walls” of the box will be. These walls should just touch the outside of the box and form a closed shape such as a rectangle, triangle, parallelogram, trapezoid, etc. Though the walls need to touch at the corners, they need not be even in length.
- 3) Fashion the background piece as desired. Roll out a slab for the walls and texture as desired remembering that the inside of a wall will show as well as the outside. Using the drawing as a guide, assemble the walls by attaching two at a time to form “L”s as in standard box making. Then assemble the two “L”s to form the box and when dry, attach the box to the background. Slip as needed to ensure a good bond, dry the piece and fire as usual. If the walls warp a bit, they can be straightened with a flat nose pliers. Test the fit by inserting the object to be set (figure 13). It should be a tight fit but if it’s too tight, either the object or the inside of the wall can be sanded or filed to fit. Remove the object.

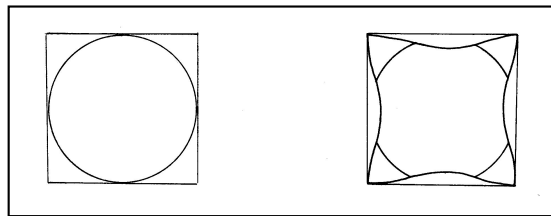
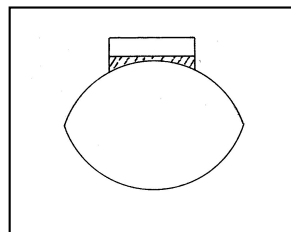


figure 13

figure 14

- 4) Finish the piece as desired and insert the object. Using your fingers, a wooded dowel, piece of plastic or even a bezel pusher, tilt the walls in toward the middle of the object. It is best if the wall starts to tilt in as close to the bottom of the wall as possible just above the thickness of the object inside the wall. Once all the walls have been tilted enough to hold the piece in place, you can start to play with how far in they tilt, how much of the length of the wall tilts in, and if you want all the walls to tilt in evenly or not (figure 14).

figure 15



### **VARIATION**

If the box is to be formed on the top of a curved surface such as a lentil bead, the object to be set will not sit flat against the bottom of the box. To even out the

bottom, a layer of epoxy resin can be poured into the box (figure 15). If placed on a level surface to set, the epoxy will self-level and the object can then be set as above. If using this method, it is important to make the sides of the box higher to allow for the curve of the bead. The bottom of each wall would also have to be curved to fit the curve of the bead where it will sit.

### **MICRO FASTENERS: or how to screw-up your connections and like it**

So far, the cold connections we have used have been part of the actual piece or, as with rivets, a connector we fashion our selves. However, this need not always be the case. The next time you're in a hardware store, take a look around and you will see that there are literally hundreds of mechanical connectors available. Generally, in jewelry making we don't think of these items as being applicable to what we do, but in fact, many are. Consider the rivets I spoke of earlier. What if, instead of making a head on one end and inserting the rivet through a hole, there was already a head on the wire? And what if, when the wire came out the other end of the hole, it didn't need to be hammered to form a second head, but rather you could just slip on another piece of metal, twist it a bit, and have the entire thing stay in place. I have just described a nut and bolt and they can be a huge asset in working with PMC and many other materials.

One of the reasons we don't often think of hardware store items as being applicable to our jewelry is the scale involved. While this is true, it is also true that there are many hardware items produced at exactly the jewelry scale. For this demo I will be considering only nuts and bolts and washers, but there are many more possibilities to be found on-line ([www.microfasteners.com](http://www.microfasteners.com) is one). The size bolts I most often use are equal to 14 gauge wire (#80 in bolt talk) however, they are available both smaller and, of course larger. The nuts, bolts and washers pictured are brass but they also come in steel, stainless steel, and aluminum.

As I said above, the jewelry applications for nuts and bolts can be thought of much the way we think of rivets. One important difference is that nuts and bolts allow the pieces to be assembled and reassembled countless times. This may be important when trying to fabricate a piece with many parts that need to be placed and then removed to allow for reshaping or refinement. They also permit the use of very fragile or brittle parts that would not stand the stress of riveting. When used in certain ways, they also allow a piece to be "perched" in/on another piece so that it almost appears to be floating (see variations). If nuts are fired into a piece of PMC, other elements can be bolted in placed and then removed and reassembled to form a different design. Finally, the heads of the bolts, the nuts that are threaded on, and the washers that act as a buffer between the bolt head and the surface of the material may be left as is or altered in many ways to enhance the design of a piece (see variations). The instructions for the use of nuts and bolts are quite straightforward and, while I list two methods and a variation here, there are countless combinations and variations possible. My advice is to get some and play.

### **Method 1**

- 1) Arrange the elements of your piece as desired. Mark where the bolts need to be placed to hold the elements together.
- 2) Drill a hole, the same size as the bolt (#80 bolt = 14 gauge wire = # 52 drill). This may be done while the elements are held together or you may drill the top piece separately and then use it as a guide to position and drill the hole for the next piece.
- 3) Insert the bolt until the head sits flat upon the surface of the top element and has protruded through all the elements to be connected. If the top element is a softer material, or if the head of the bolt will be twisted to tighten it, a washer should be placed on the bolt before it's inserted.
- 4) Place a washer on the end of the bolt, thread the nut onto the bolt, and tighten as desired. It should be noted that the nut exerts a great deal of force and needn't be over-tightened.
- 5) Trim the protruding bolt with a wire cutter and finish as desired.

### **Method 2**

- 1) Place a ball of wet PMC onto the back of a fired or unfired piece of PMC and push the head of a bolt into the wet clay. Position the bolt straight up and smooth the clay around the head.
- 2) Allow to dry. Fire the piece in vermiculite with the bolt pointing down.
- 3) After firing, finish the piece as desired and drill a hole to accept the bolt and attach as above.
- 4) Alternately, the bolt may be attached to the front of a piece if the other elements are to be mounted on top of it. This would mean that the nut and washer might show (or be covered by another element) but this could be incorporated into the design of the piece.

### **Method 3** – trapping the nuts in PMC

- 1) Roll out a sheet of PMC, 5 cards thick.
- 2) Cut a 1/8" hole wherever you would like to place a nut and push a nut into each hole. The PMC can be smoothed up over the edges of the nuts to form a lip after firing and ensure a secure fit.
- 3) Fire and finish as desired.

### **Variations**

- The trapped nuts in method 3 allow for elements to be threaded into the nut so that the way of attachment is hidden. Consider a ball of PMC fired with a bolt protruding from one section and then threaded into a bolt in a flat slab of PMC. You would see neither the bolt nor the nut and the ball would appear to be "floating" on the surface (figure 16).

- Cut the head of the bolt off and heat the end of the bolt to form a ball. Thread elements (beads, fired PMC pieces, etc.) onto the bolt and attach to the trapped nuts in method 3.
- Remove and heat the head as above and hammer, file, sand, or saw into a form.
- Alter the nut the in the same ways.
- Make washers from any material and in any shape to enhance your piece. It is easier to drill the hole in the washer material before cutting it out, as you will probably have a rather small piece to hold. Washers can also be stacked to make as many layers as desired (figure 17).

figure 16

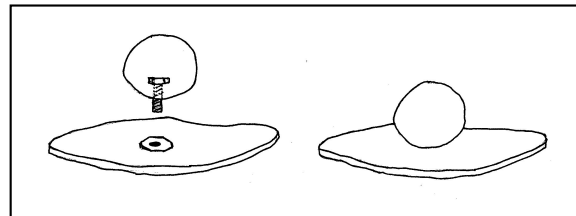


figure 17

