METAL SHAPING EQUIPMENT

BY RON COVELL

This is the second in a series of articles about working with sheet metal, which will continue bimonthly over the next year. In this article we will look at Wheeling Machines, Planishing Hammers, Beading Machines and various metal shrinking tools.

In our first article we showed some of the common hand tools used for sheet metal fabrication. Although it is possible to do some amazing things with very simple tools (as we will see in future articles) some of the equipment designed for metalworking can really speed the process and ease the fabrication of high-quality sheet metal parts.

To the uninitiated, the wheeling machine is probably the most mysterious of the metal shaping tools. Often called an English wheel, it is a deceptively simple machine, generally comprised of a C-shaped frame holding two wheels. The upper wheel is flat, usually around 8 or 9 inches in diameter, and the lower wheel is crowned, with a screw mechanism to raise and lower it to vary the pressure exerted on the metal. These machines have been around for many decades, and most of the early ones were made of cast iron. More recently, machines with frames fabricated from structural steel have become popular, since they work quite well and are much more affordable and easier to transport. There is still a mystique about the old cast-iron machines, so they remain both desirable and expensive.

In use, sheet metal is rolled between the upper and lower wheels in a pattern which generally covers the whole surface, and the metal domes up because the center of the panel stretches, or becomes "raised," more than the edges. The operator has several variables to deal with, including the pressure between the wheels, the pattern used to track across the panel, the number of repetitions of a pattern on a panel, and the curvature of the lower, or "anvil" wheels. Most good machines come with a matched set of anvil wheels with graduated radii.

Watching an experienced operator use the wheeling machine is a feast for the eyes to anyone who appreciates fine metalwork. It is almost magic to watch the metal subtly take on smooth, sensuous curves, apparently without much effort on the operator's part. Even more appealing, all of this is accompanied by soft rolling sounds, notably different from the noisy hammering generally associated with making sheet metal take on a compound curve. Usually when a newcomer tries using the wheeling machine, they discover that although little effort is required, there is certainly a subtlety of technique involved, which takes some time to master.

The planishing hammer is a tool that has a stationary bottom die, and an oscillating top die that hammers against it. The power source is generally pneumatic, and the machines come in a wide variety of styles and sizes. It is a very good analog to the handheld hammer and dolly, but it greatly speeds the process of planishing (making smooth by hammering) sheet metal panels and welds. Most machines have a lower die that is easily changed, and dies are usually selected to closely match the desired contour of the panel you're forming.

Although it is possible to do a limited amount of doming on metal using the planishing hammer, it is not generally used as a shaping machine for larger panels. It is often used to smooth metal shaped in some other manner, such as with a mallet and sandbag.

Beading machines, also called rotary machines or combination machines, are

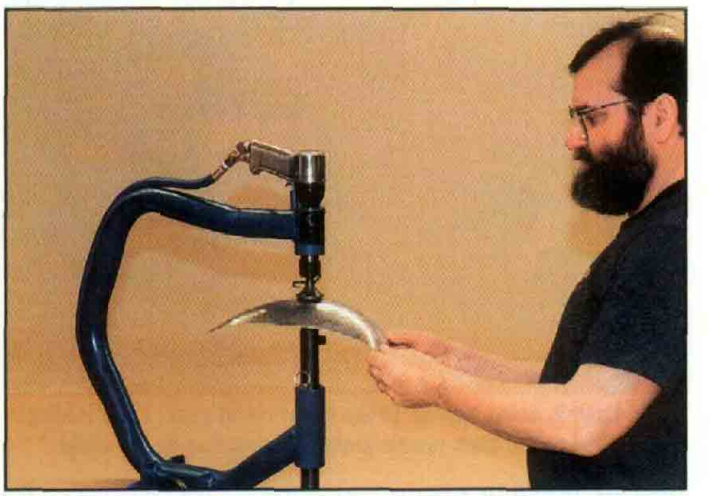
This is a modern, fabricated frame wheeling machine, being used with a low crown lower wheel to put a very slight compound curve in a sheet of aluminum about two feet square.

You can see there is crown both right to left and front to back on this panel. This has resulted from about two minutes of wheeling time. Note how glassy smooth the surface is.

In this shot you can faintly see the tracks left by the wheels. The tracks are so close they almost touch. The more uniform you can maintain your tracking pattern, the smoother the panel will stay while being shaped.

Here is a smaller panel being shaped with a higher-crown wheel. There is about 80 pounds of pressure between the upper and lower wheels, and it is quite easy to roll the sheet metal between them.

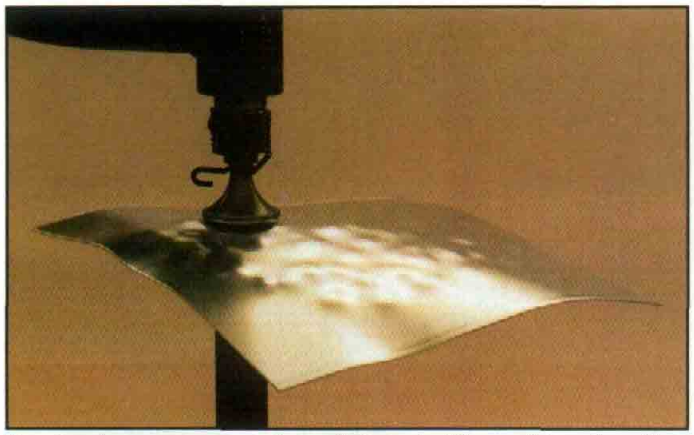
Again, notice the smoothness of the sheet metal surface. Skilled operators of the wheeling machine can produce work so smooth it looks machine stamped!



This is a pneumatic planishing hammer, being used to smooth a small domed panel originally roughed out with a mallet and sandbag.

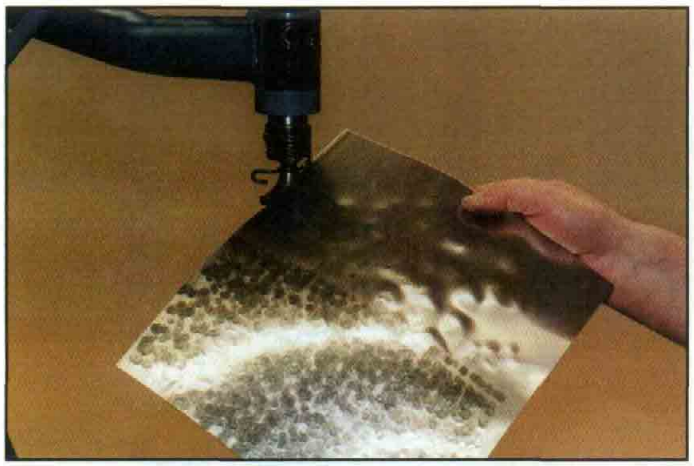
another versatile tool for forming beads, steps, flanges, and other details in sheet metal panels, and they can also be used to help create wired edges. These machines are available in a wide range of sizes and styles, but they all use round dies with matched contours to do their work. The throat depth of the machine determines how far from the edge a detail can be placed on a panel, and various machines have throat depths from 1" to 24".

Shrinking is one of the most difficult aspects of sheet metal work to accomplish using only hand tools. While it is possible to do some shrinking on high-crown panels by simply using the hammer-off dolly technique, it is extremely difficult to cause sheet metal to shrink in the middle of a low-crown panel, or on an edge, without the use of either special fixturing or heat. Mechanical shrinking machines really shine in these situations, and



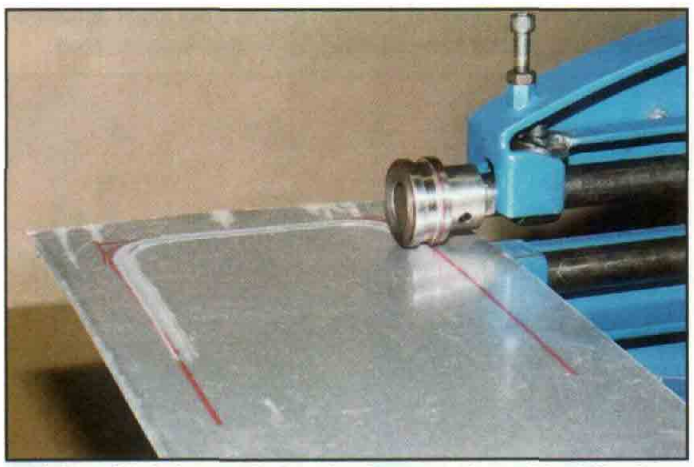
Here is a lower-crown panel, rough shaped with a mallet and sandbag before being smoothed in the planishing hammer. We intentionally left this panel very lumpy top show just how much smoothing the machine can do.

This is the same panel after being planished (smoothed) on just one side. This represents about one minute of planishing at moderate pressure.

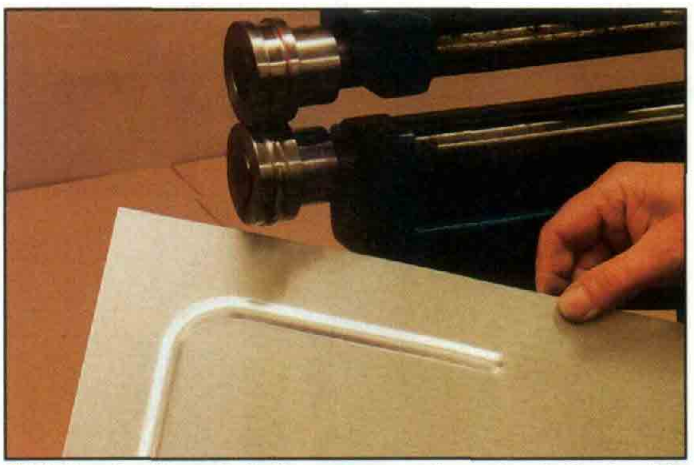


In this shot, the panel is completely smoothed. It's hard to believe this was that same lumpy, rough-shaped piece only two minutes ago!

This is a beading machine with an 18″ throat depth.



A 3/8″ bead is being applied to the sheet metal panel by following a line marked on the clear plastic protective covering on the sheet.



With the plastic peeled off, you can see how cleanly the bead is formed.

they are found in a variety of styles. Even the lowest-cost shrinking machines can add a new dimension of capability for a novice metal fabricator, and the more expensive versions are often one of the most used tools in a professional metal fabricator's shop.

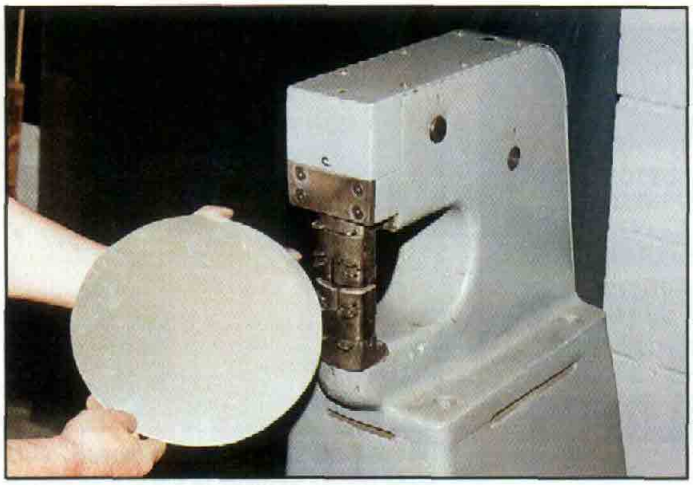
The most common type of machine has two top and two bottom jaws with textured faces which contact the metal. In use, the jaws grip the metal, then the left and right sets of jaws are forced together, causing the metal to move with them. This makes the grains of metal interpenetrate slightly, effectively shrinking the metal, and causing it to become slightly thicker as well. On most machines, the entire jaw cartridge is removable so a stretching jaw set can be used in the same machine. Most professional shops have two separate machines to save time when switching between shrinking and stretching.

The most inexpensive power shrinkers are based on the hand shrinking machines, and have only a 1″ throat depth, limiting their use to the edges of panels. But even just working the edge can often affect the shape of the panel several inches inboard. One disadvantage of the inexpensive machines is that the dies leave distinct lines embossed in the metal, which can become stress risers in critical structural applications. In many non-structural applications, these marks are of no consequence, and if the

This is a pneumatically operated power-shrinking machine. Even though the throat depth is only 1", it can still do some great work. Notice the tightness of the bend it was able to achieve in this aluminum angle.

material is thick enough, the lines can be sanded out with no problem. The more expensive machines usually use a stippled texture on the face of the dies, which greatly diminishes this problem. Some of the high-end machines have special (and very expensive) dies that leave no marks at all.

There are several varieties of deep throat metal shrinking machines available, with throats from 5" to 48" in depth. Erco, Marchant, and Eckold are some of the best known makes of machines in this range, and although they



This is an Erco kick shrinker with a 5" throat depth. The flat disk will be domed solely by shrinking the perimeter.

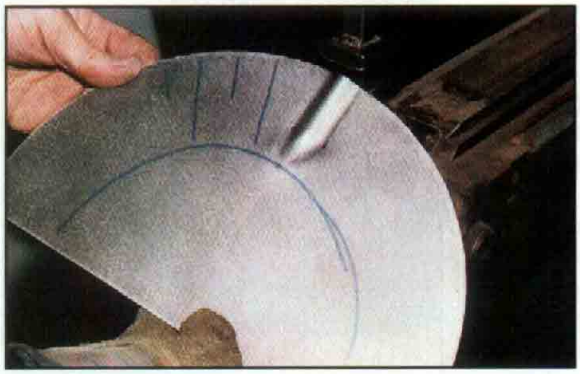
You can see h ow the machine can easily reach the center of this part, and how uniformly domed it is by careful shrinking around the edge.

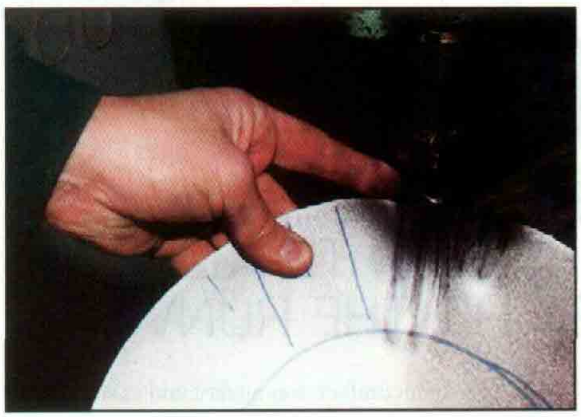
This is a special set of "thumbnail" dies made for the Pullmax to allow it to shrink sheet metal panels.

are fairly expensive new, it is sometimes possible to find used machines in very serviceable condition.

There is another class of metal shrinking machines available that operate on a different principle, known as "stack shrinking." Power hammers are the tools which are most often used for this process, with a special set of "thumbnail" shrinking dies, but fairly recently dies which work on this principle have been developed for smaller, more affordable reciprocating machines such as the Pullmax. These dies seem to shrink metal to an amazing degree without causing much work hardening!

The accompanying photos show these machines in action, and should give the reader some insight about the capabilities of these marvelous tools. In the next installments of this series, we'll see how the tools and techniques covered in the first two articles can be put into use making some actual aircraft parts. ◆





With the dies installed in the machine, a sheet metal panel is pushed between the oscillating dies, creating a "molehill" shape.

When the metal is pulled back out of the dies, the metal is flattened out, causing it to shrink. It is easy to build up shrinking passes almost without limit, creating deep bowl shapes in sheet metal panels.

You can see how deeply this panel was dished with about 5 minutes of shrinking time on the Pullmax. This type of shrinking is called "stack" shrinking, and it work hardens the metal much less than other types of mechanical shrinking.

ABOUT THE AUTHOR

Ron Covell has been a professional metalworker for over 35 years. He operates a business, Covell Creative Metalworking, offering a complete line of metalworking tools, books and videotapes, as well as offering a series of metalworking workshops nationwide. You can reach him at 106 Airport Blvd., #201, Freedom, CA 95019, 831/768-0705, or you can send email to covell@cruzio.com