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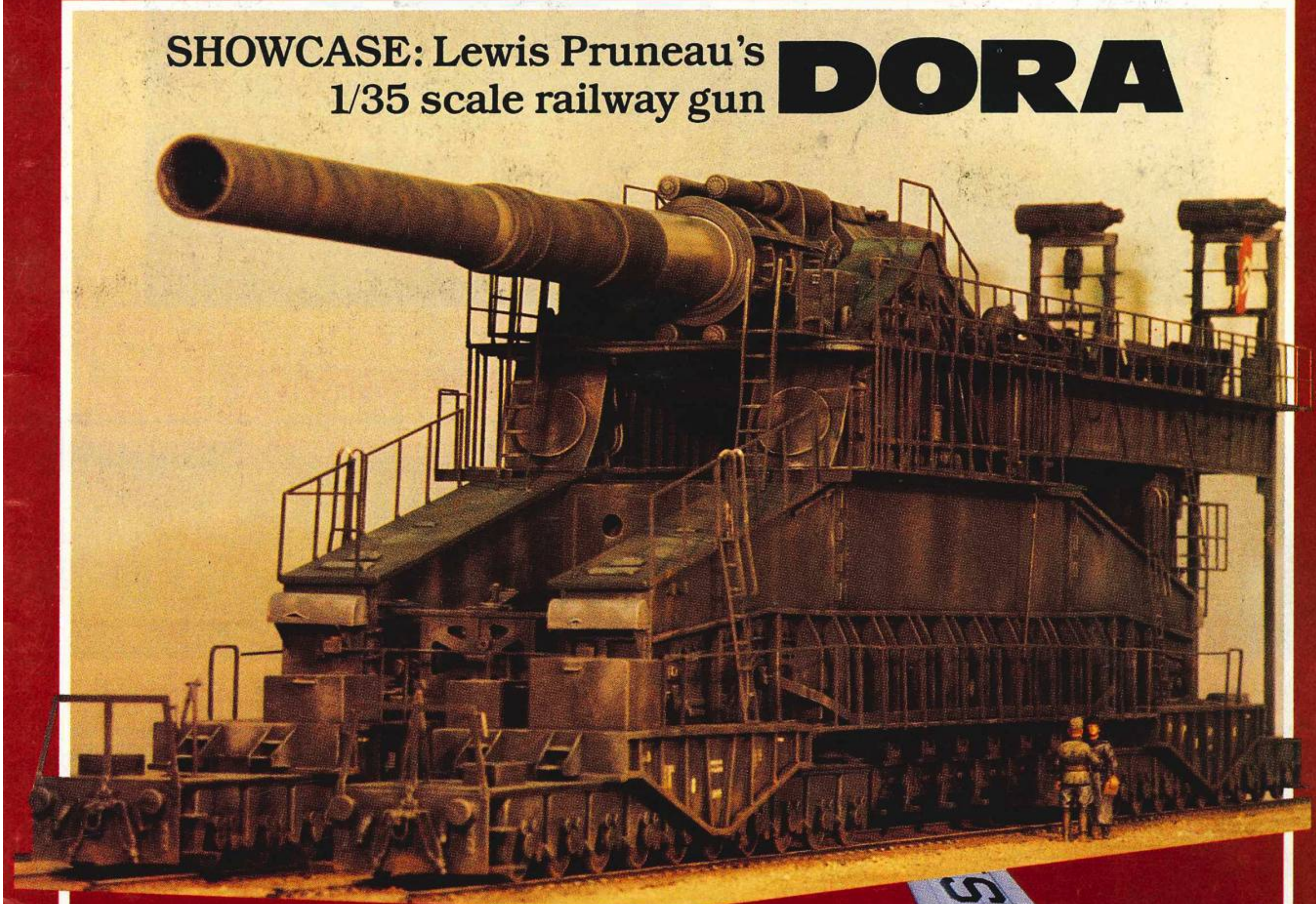

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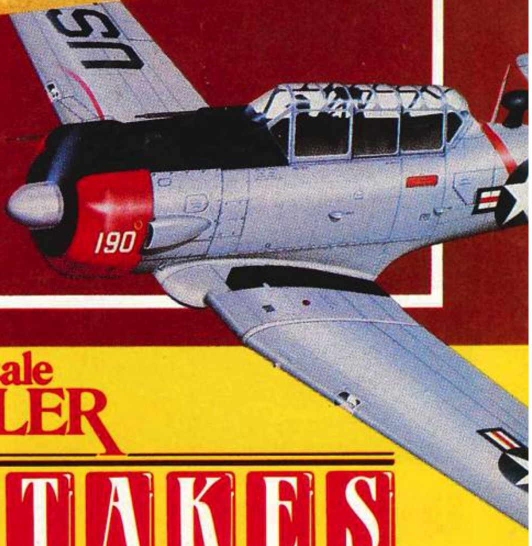

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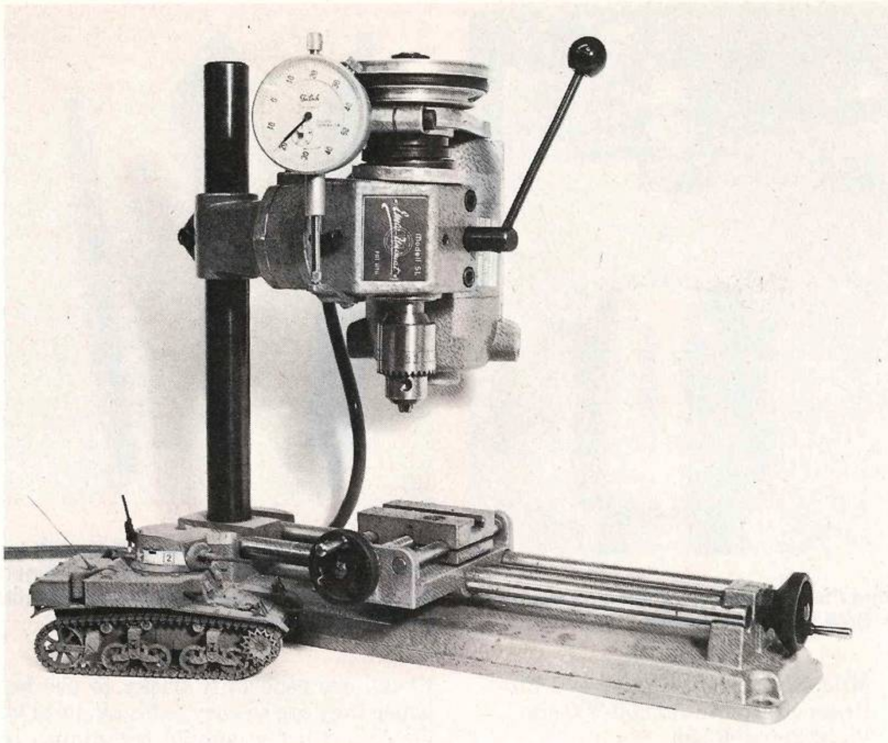


The author's Unimat SL set up as a drill press. Paul added the dial indicator so he can measure the depth of cuts while milling. The tank is 1/35 scale.

Modeling with a drill press

Tips and techniques for drilling holes and embossing rivets

BY PAUL BUDZIK

AS YOU HONE your modeling skills and improve your results from project to project, precision becomes more and more important. While some modelers achieve truly impressive results with nothing more than a modeling knife and tweezers, others — including me — enjoy using machines. This article is a brief introduction to the drill press, including techniques for using a drill press for several common modeling tasks.

If you are thinking about buying a drill press for use in modeling I strongly suggest a small machine such as the Unimat. Although you can use a full-size drill press for modeling, the miniature machine is more convenient in many ways, and a wide range of accessories is available.

If you already have a drill press, it probably came with an operating manual. The manual provides specifics on your machine, and you should become familiar with them, but the basic manual seldom includes information applicable to small-scale modeling. Even if you have a machine designed for small work, such as a Unimat, you quickly find that the manufacturers' ideas of "small" are different from our ideas.

Fig. 1. A drill chuck (left) and a collet chuck. The disadvantage of the collet chuck is that it requires a different collet (the piece shown above the chuck) for each drill size or tool shank.

About chucks and collets. The primary function of any drill press is to drill holes, and the usual way to hold the drill is a chuck, Fig. 1. The most common type is a drill chuck, which can accommodate a wide range of drill sizes. This is the type of chuck you'll use for more than 90 percent of your drill press work.

A second type is the collet chuck, which requires a set of interchangeable collets to accommodate various sizes of drills and cutting tools. Although the collet chuck offers a small advantage in accuracy over the drill chuck, it is more expensive because it requires a different collet for every drill size. The collet chuck grips very tightly, and with small drills this is more likely to cause breakage. I use my collet chuck infrequently, mostly for milling operations or when a drilling operation requires the ultimate in precision. All in all, it's a luxury, not a necessity.

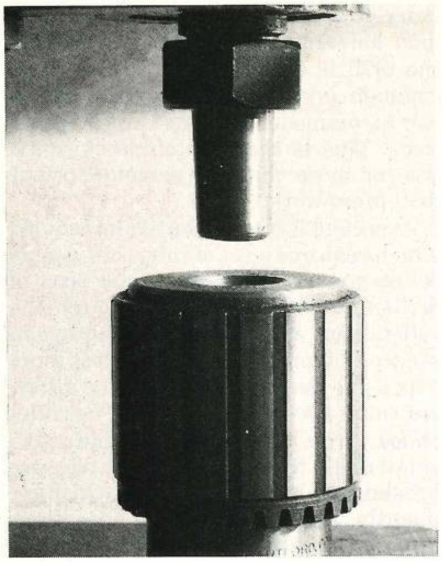
Chucks can be attached to the drill press spindle in different ways. One method incorporates a tapered shaft on the chuck that mates with a tapered socket on the drill press, Fig. 2. Such a mounting is fine for drilling operations, but when the chuck is subjected to lateral forces (for example, when milling or sanding), the socket can loosen. Chucks can also be threaded onto their spindles, Fig. 3, and this type of mounting is more secure for milling and sanding operations.

Choosing drills. Absolutely essential for modeling is a set of twist drills in numbered sizes 1-80. Drills are manufactured from, in order of hardness, carbon steel, high-speed steel, and carbide steel. While carbon steel drills are easy to sharpen and relatively inexpensive, they dull quickly. Unless nothing else is available, avoid buying carbon steel drills. Carbide drills are good, but they are expensive — and brittle, so they break easily.

High-speed steel twist drills are the best choice for modeling. Although they are more expensive than carbon steel drills they stay sharp longer, and they are less likely to break than carbide drills.

In addition to a set of twist drills you'll need a couple of center drills, Fig. 4. These are used to locate holes on the model before drilling with a twist drill, much like a center punch is used in metalworking. The center drill creates a small, precise depression at the drilling site which keeps the twist drill from wandering, Figs. 5 and 6. You don't need a center drill for locating holes for single details such as grab irons or handles, but if you have to drill a row of accurately spaced holes using the graduated dials on the Unimat milling table, you'll probably want to use a center drill.

Small center drills suitable for mod-



Figs. 2 and 3. (Left) a drill chuck with a socket that fits on a tapered shaft, and (right) another chuck that screws onto a threaded arbor. Both types are common.

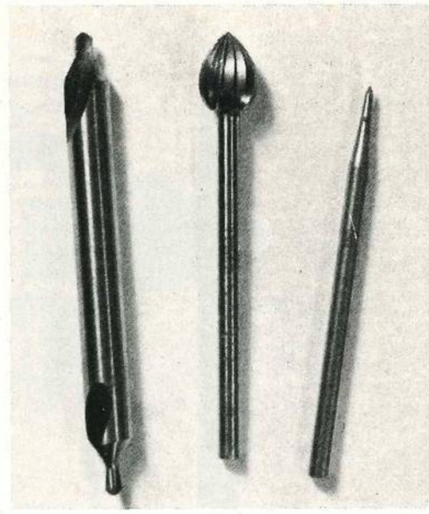


Fig. 4. Bits for center drilling. From left to right: a commercial center drill, a Dremel flame burr, and a homemade center drill ground from a broken burr.

eling are available, and a small countersink can be used as a center drill, but for the smallest drill sizes I use a Dremel cutter called a "flame burr" (Fig. 4). I've also used homemade center drills made by grinding flats on the end of a shank of a broken burr or drill.

Drilling speeds and lubrication. The correct speed for drilling depends on the material being drilled and the size of the drill bit. The formula for figuring the correct speed is:

$$\text{rpm} = \frac{4 \times \text{sfm}}{\text{drill diameter}}$$

where sfm is the desired surface speed (a machining term) of the material. Average surface speeds for some common materials are:

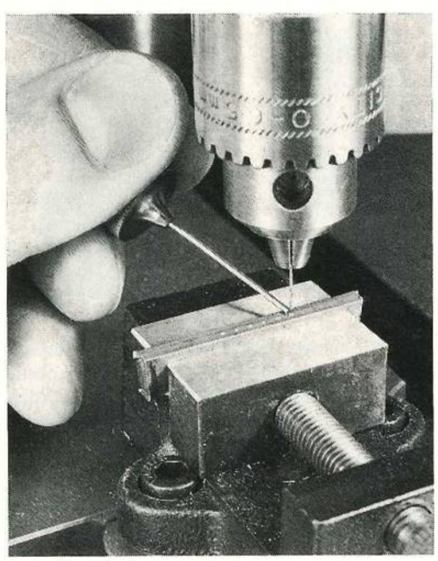
Stainless steel and plastic 20-40 sfm
Mild steel or cast iron 80-100 sfm
Brass or aluminum 200-300 sfm
Wood 300-400 sfm

What all this boils down to is that you'll need to slow the drill press way down for drilling plastic. Given the small drill diameters used for most modelwork the cutting speed of the drill is far less critical than the heat buildup at the drill tip.

Lubrication is important, particularly when drilling metal, Fig. 6. Because the oil functions not only as a lubricant but also aids in cooling and chip clearance, use a lightweight oil. Lubrication becomes a necessity when using the miniature drills (sizes 75-80), and it is highly recommended for drilling most steels with any size drill.

Using small drills. Small drills, sizes 61-80, are especially tricky to use because they are so easy to break, but I've developed a few simple techniques to make them last longer. First, when drilling with the small sizes I rarely use the chuck key to tighten the chuck; instead, I use finger pressure alone. Using the key means the chuck will grip the drill tightly — and if the drill grabs, chances are good you'll need a new drill. Hand tightening is adequate and much safer.

Second, it's important to develop a sensitive feel — never feed a small drill with force. Instead, let the drill do the cutting, and take it slowly. My normal procedure for drilling a small hole goes like this: Locate the hole with a center drill, then remove the center drill and replace it with the twist drill



Figs. 5 and 6. (Left) Paul spot drills, or locates, a row of evenly spaced holes by mounting the work on a milling table and advancing it with the handwheel. Next he replaces the center drill with a twist drill (right), adds a drop of oil, and completes the holes.

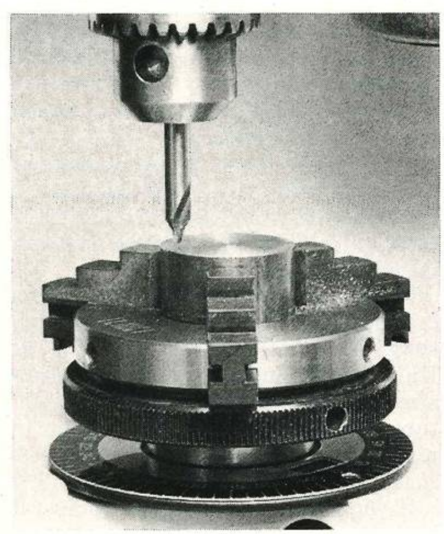
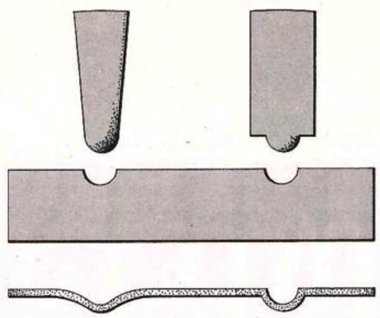
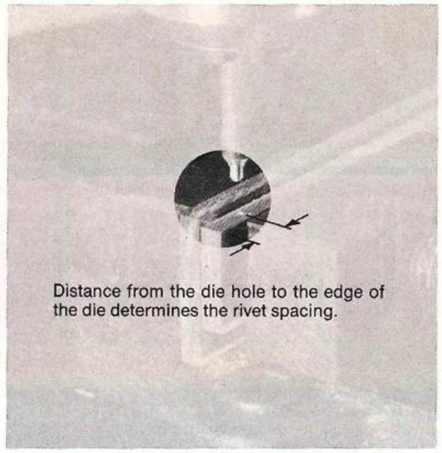


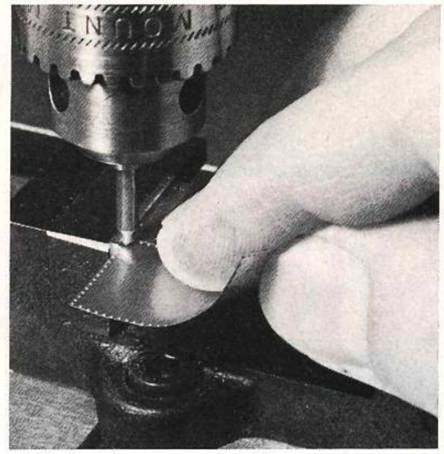
Fig. 7. A three-jaw lathe chuck in use as a work holder on the drill press table. This is far more precise than hand-holding the work — and safer, too.



A plain, tapered punch yields an indistinct rivet head. . .but a shouldered punch embosses a sharp, crisp dimple.

Fig. 8 RIVET PUNCHES





Figs. 9 and 10. (Left) A punch-and-die setup for embossing rivets. Here the punch is brass, the die acrylic plastic. (Right) Adding rivet detail to a brass panel. Care is required to ensure that the corner rivets wind up in the corners.

(a good reason for using a center drill about the same length as the final drill). Place one drop of oil in the depression left by the center drill, then begin drilling by carefully lowering the drill. Watch to make sure the drill finds its way into the depression, then let the drill down a few thousandths of an inch and quickly withdraw the drill. Repeat the process, feeding the drill into the material in .005″ to .010″ increments.

Withdraw the drill between cutting cycles to clear chips from the hole. Add oil if necessary to maintain good chip removal — you don't want oil all over the place, but there should be enough to help float the chips out and keep the cutting tip of the drill free. The deeper you go the more cautious you should be, because the chances of the drill binding become greater. If you are going to drill a deep hole I recommend using a new drill as it will be sharper and will clear chips better.

Avoid hand-holding your work while drilling, because doing so leads to inaccuracies and broken drills. Whenever possible clamp the part to be drilled to the drill press table or hold it in some sort of vise; a drill press vise is a must, and three- and four-jaw lathe chucks also work nicely for holding the work, Fig. 7.

Tips for drilling plastic. Drilling plastic presents special problems, most of them related to heat buildup at the cutting tip of the drill. First, as mentioned above, run the drill at a low speed and withdraw it frequently to clear chips and allow it to cool. Try to keep the amount of time the drill is in the material to a minimum, because feeding the drill slowly can make the plastic heat up and melt around the drill instead of cutting cleanly.

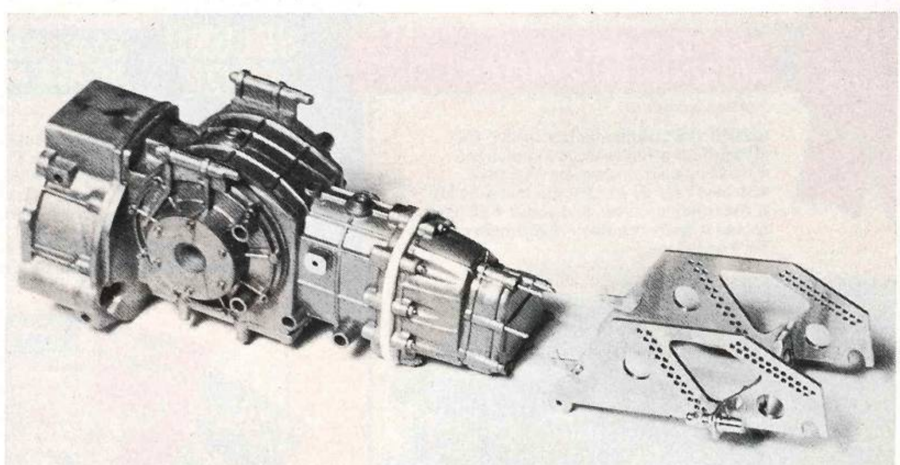
When drilling several holes the same size be sure to allow the drill to cool between holes (if you are in a hurry, switch drills!). When drilling deep holes I generally start with a drill a few sizes smaller than the final size, then finish up with the correct size. This procedure removes less material with each cut, which minimizes heat buildup and improves chip clearance.

The drill press as a rivet maker. Another use of the drill press is as a rivet embossing tool. The only accessory required is a punch, which you can file from a piece of brass rod chucked in the drill chuck, Fig. 8. (A brass punch is adequate for embossing soft materials such as plastic, aluminum, and brass, but if you plan to emboss steel or want a long-lasting punch, make it from drill rod.)

To make crisp rivets the punch should force the material into a matching hole in a die placed underneath the material. Make the die from acrylic, brass, or steel, depending upon the material you plan to emboss, Fig. 9. With a little ingenuity you can set up stops and guides so your rivet lines will be straight with rivets uniformly spaced.

I usually make the distance between the edge of the die and the hole equal to the desired spacing between rivets. To do this I measure and mark the distance from the edge of the die material to the hole, then clamp the material on the drill press and spot and drill a hole at the marked location. I replace the drill with the rivet punch and I'm ready to go. You simply punch the first rivet, shift the material so the first rivet drops just past the edge of the die, then punch another rivet and repeat the process. The result is an entire row of perfectly spaced rivets, Fig. 10.

Just as it takes practice to become proficient with tweezers, you won't feel comfortable with your drill press the first time you use it, but given time, the techniques become almost second nature. Once they do, you'll wonder how you ever managed to model without this helpful machine. **FSM**



Paul's favorite modeling subjects are large-scale racing cars and motorcycles, and he scratchbuilds many of the components. Drilling the numerous holes in this metal mounting bracket for the rear wing of a 1/12 scale McLaren M-23 was a job made for a drill press. The modified plastic part to the left of the bracket is the transaxle.