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How to Work with Copper Piping  
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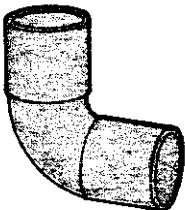
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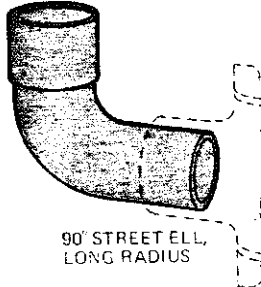
# How to work with copper piping

# X198C

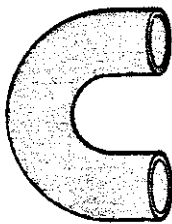
## TYPICAL PRESSURE FITTINGS



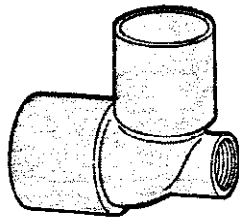
90 ELL, CLOSE ROUGH



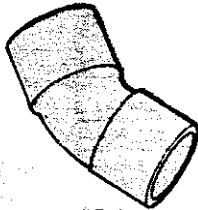
90° STREET ELL, LONG RADIUS



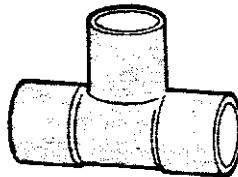
RETURN BEND



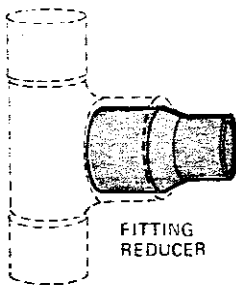
BASEBOARD TEE



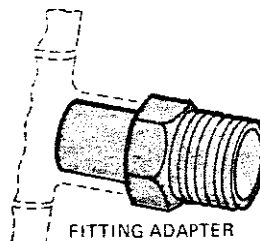
45° ELL



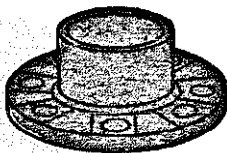
TEE



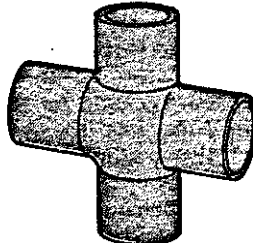
FITTING REDUCER



FITTING ADAPTER



COMPANION FLANGE NO. 125 STANDARD

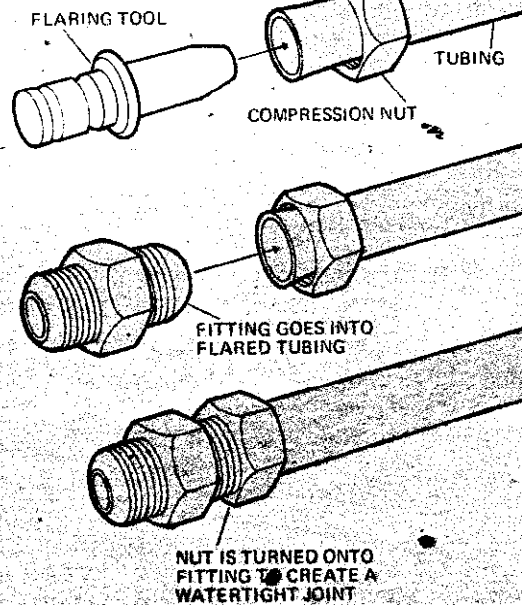


CROSS

Copper piping is light and extremely durable, requires no threading of the ends to join it, comes in varying diameters, wall thicknesses and degrees of hardness, and is suitable for both hot and cold-water systems. To join copper piping, there are many types of fittings to cover every part of the plumbing layout. A number of common fittings are shown at the left.

Copper pipe can be joined using either soldered (also called capillary or "sweat" joints) or screwed (compression fitting) joints. Compression joints are of two types. With the first, called a "bead" fitting, the tubing is pushed into the fitting, a bead of jointing paste is applied around the tubing in front of a compression nut, and the compression nut is tightened onto the fitting. The result is a watertight fit. The second type is called a "flare" fitting because the end of the tubing is funnel-shaped with a special flaring tool (below). This shaped end receives the male end of the fitting; the compression nut is then tightened to finish the connection.

## FLARED JOINTS

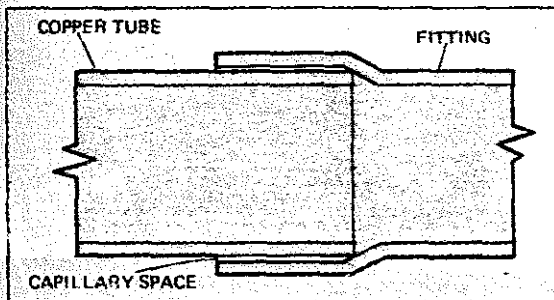


### Types of copper piping

Type	Temper
K	Hard (rigid) or soft (flexible)
L	Hard or soft
M	Hard only

To be sure the type of copper piping that you use for a specific application complies with local plumbing code, always check with your local building department. In general, Type L can be used below ground, Type M above ground. For a superior installation, use Type K below ground and Type L above ground.

### Capillary or 'sweat' joints



Properly prepared, a sweated joint will provide many years of troublefree (nonleaking) service. Although your joint may leak the first couple of times you attempt to sweat pipe, you'll soon be sweating copper pipe just like a pro by getting a little practice under your belt and by following the rules outlined on these pages.

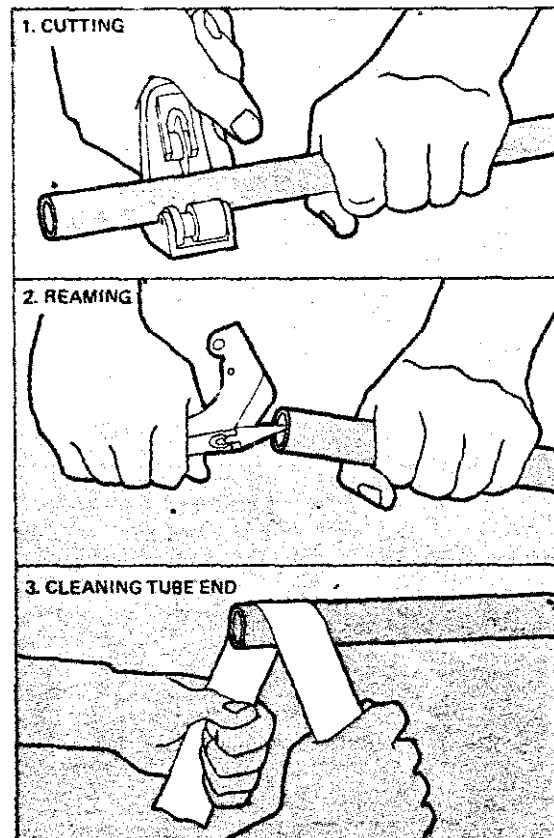
To understand the principles of sweating pipe, you should understand how capillary action works. When the end of a copper pipe is inserted as far as possible into a fitting, a small amount of space will remain between the inside wall of the fitting and the outside wall of the pipe. When the fitting is heated with a propane torch and solder is applied around the pipe at the outer edges of the fitting, the solder will be drawn into this space by capillary action, bonding the pipe and fitting together securely. Such action will be the result regardless of whether the piping will be running horizontally or vertically.

If you're repairing or adding to an existing copper piping system, remember that all parts to be joined first must be completely dry. After the soldering is done and the joint cooled to room temperature, test the work for possible leaks.

### Equipment needed

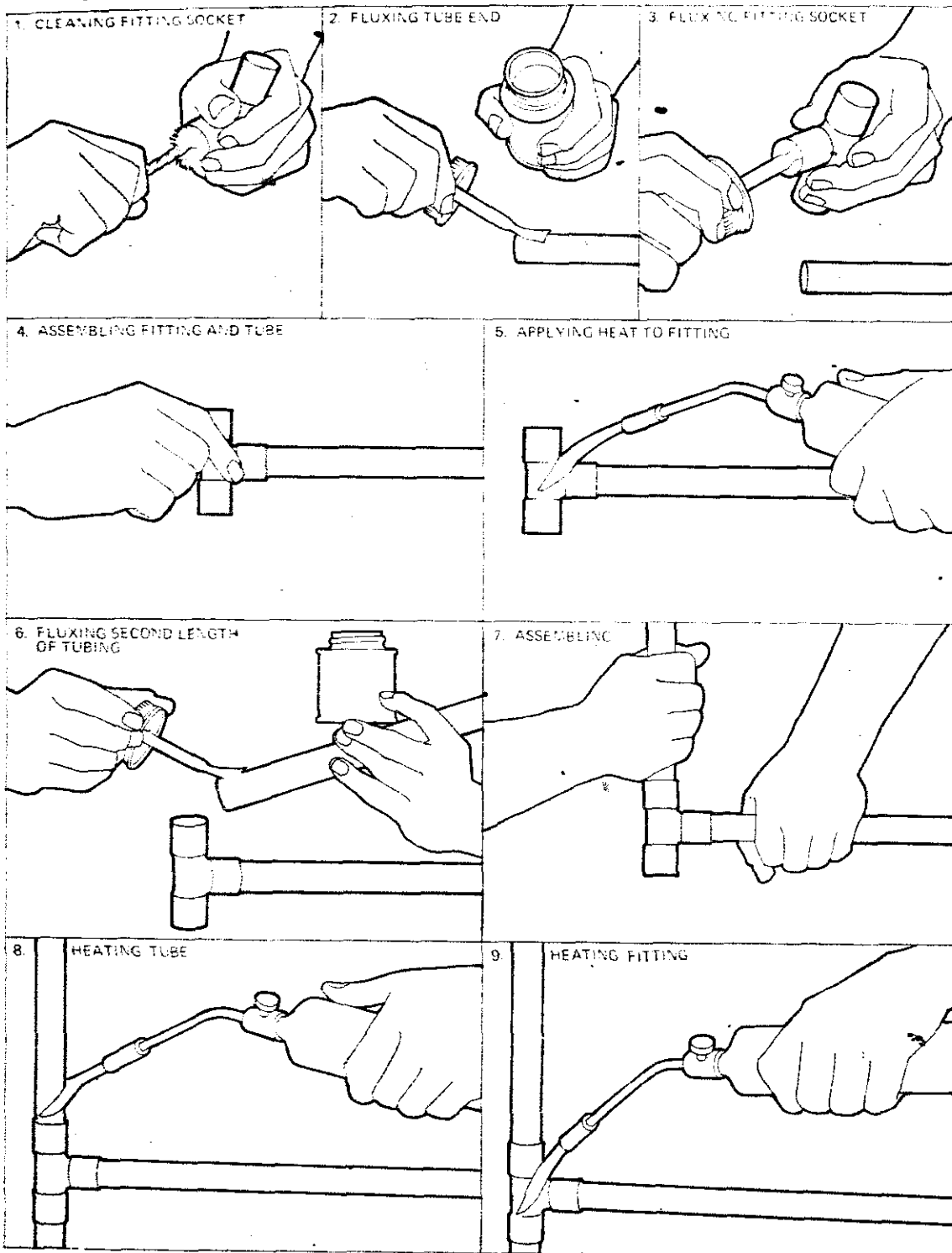
Propane torch	Tubing cutter
Hacksaw	with reamer
Smooth file	Sandpaper or fine
Tubing bender	steel wool
(also known as	Solder
a "hickey")	Flux

### Cutting and cleaning

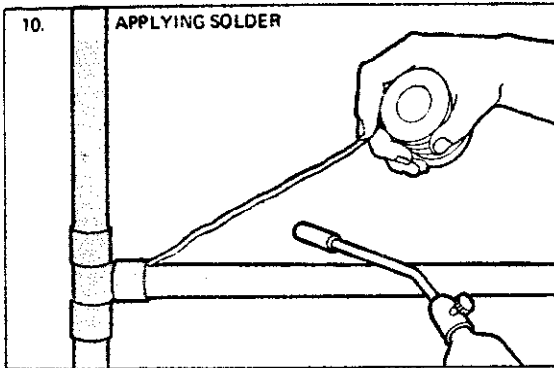


Cut pipe to length using a tubing-cutter (1) or a fine hacksaw blade. Make sure the cut is square and the pipe remains round and true. Cutting with a hacksaw blade leaves rough edges on the inside and outside of the pipe, while a tubing cutter leaves rough edges on the inside of the pipe. Remove burrs on the outside of the pipe with a smooth file or sandpaper and on inside with a reamer (2) or rattail file. Clean the end of pipe with steel wool or a strip of sandpaper (3).

## Ten steps for assembling copper piping



Clean the inside of the fitting with a wire brush. A thorough cleaning is absolutely necessary because a "sweat" joint relies on capillary action and any dirt, grease, or surface oxidation on the pipe or the fitting will hinder the joining action. Because the pipe should fit tightly into the fitting, do not remove too much metal when sanding or the capillary space will be enlarged and the joint weakened.



### Assembling copper system

After you have thoroughly cleaned the inside of the fitting socket (Step 1, left), apply a thin coat of flux to the end of the pipe (Step 2) and the inside of the fitting (Step 3) with a small, clean brush. Then push the tubing tightly into the fitting (Step 4) and twist the pieces slightly in order to distribute the flux evenly. Wipe off any excess flux that remains and apply heat with a propane torch to the fitting (Step 5).

In the same manner, apply flux to the second length of tubing (Step 6), insert in the fitting (Step 7) and apply a flame to both the tubing (Step 8) and fitting (Step 9). Melt the solder from a spool of soldering wire around the tubing-fitting joint (Step 10, above).

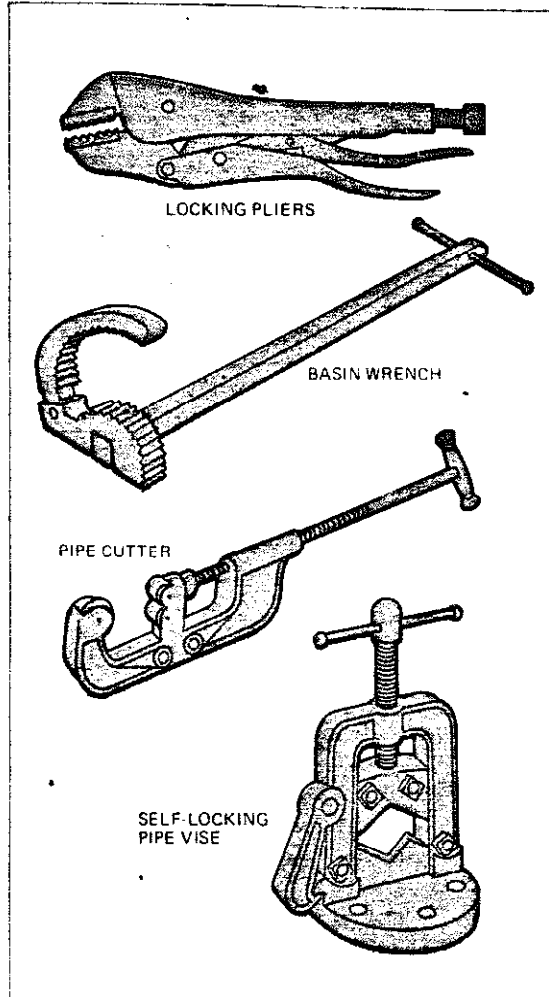
Flux for soldering is mildly corrosive. It contains zinc and ammonium chlorides in a petroleum base, and is used as a protective coating on the metal and as an agent to help the solder flow. Always stir flux before you use it.

The cardinal rule in choosing a solder is to buy a quality solder. Most solders for household plumbing jobs are composed of 50 percent tin and 50 percent lead. If the joint requires a solder of greater strength, use one comprising 95 percent tin and 5 percent antimony.

Do not clean, flux and assemble more copper piping than you can solder in about two hours.

### Soldering tips

Remember to align joints with adequate support before soldering, and to place no strain on them. When soldering, use torch with sweeping motion—tubing and fitting should be at same temperature for best flow of solder into joint. If solder forms lumps, joint is not hot enough. If there is no question that the joint is hot enough but solder still does not flow freely, overheating resulting in burned flux is likely, and the joint must be started again from Step 1. As soon as solder has set, use a wet brush or rag to crack and remove flux (remove it from inside of pipes by flushing with water); remove all flux before pressure-testing the joint—if necessary use a wire brush. If you have to redo a joint, reflux the entire joint area before applying heat to unsolder.



### Toolbox additions

If you plan on doing most of your own plumbing jobs, the four tools shown above can be valuable additions to your toolbox. The two pictured at the top are available at most hardware stores, while you may have to visit a plumbers' supply house to find the lower two.

Vise-grip pliers, with serrated jaws and locking nut, are especially useful when working with small-diameter pipes. A basin wrench, whose gripping head is adjustable, will save you many bumps and knocks on head and hands when you are installing a basin where there is little room for swinging ordinary wrenches.

A pipe cutter, which is faster and more accurate than a hacksaw when cutting iron or galvanized pipe, is operated simply by starting the cutter over the pipe, and, as it is revolved, tightening the handle gradually to deepen the cut. Thread-cutting oil should be applied to both the cutter and the pipe.

A self-locking pipe vise has V-shaped jaws that grip the pipe from both top and bottom. It eliminates the need for a helper to hold the pipe while you do the cutting. ★ ★ ★

X420A

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A project of Volunteers in Asia

Try Your Hand at Metal Spinning  
Popular Mechanics No. X420A

by: Sam Brown

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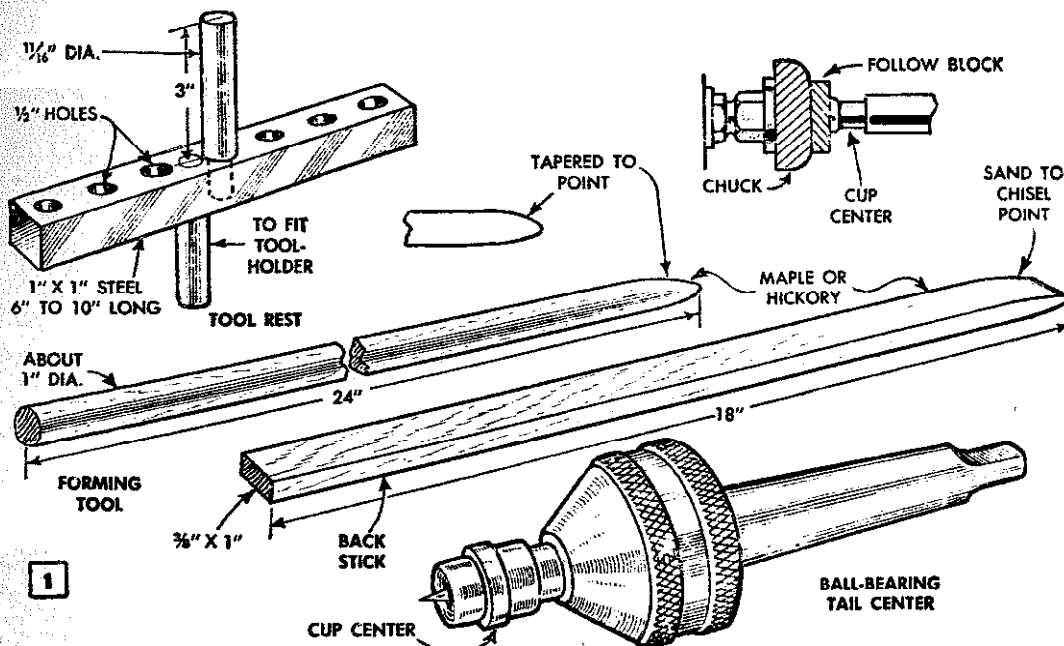
## Shop Notes

### TRY YOUR HAND AT METAL SPINNING

By Sam Brown

**I**F YOU BEGIN with soft aluminum and work it over a simple form you can spin a bowl in less than five minutes after the job is set up. Aluminum spins very easily and does not tend to score or buckle under the forming tools. It need not be annealed during ordinary spinning procedure as it will take medium-radius bends. It stretches to form tapers without cracking, and offers no undue resistance to flaring, beading and hemming. Pewter has similar characteristics but is rather expensive. For average work pewter is the easiest of all metals to spin. Copper and brass have much higher resistance to spinning and require frequent annealing.

**Equipment:** For spinning simple projects in aluminum and soft copper, all the special equipment needed is shown in Fig. 1. Wooden forming tools generally are used on these metals. For more advanced work you would need a complete set of special spinning tools, but these are not necessary for the projects detailed. In addition to the

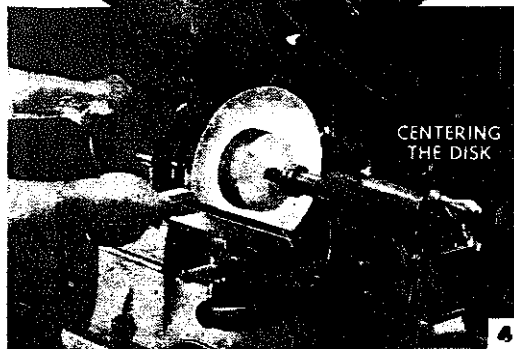




METALS	THICKNESS	ANNEAL	LUBRICANT	REMARKS
Aluminum	16 to 22-gauge. 18-ga. suitable for most work	650°—just chars pine shavings. Water or air cool	Any kind of lubricant can be used:  BEESWAX BURNISHING SOAP TALLOW TALLOW CANDLE CUP GREASE LAUNDRY SOAP	Low cost. Easy to spin. Annealing not needed for average work. Use ALCOA 2S-O or equal (pure, soft aluminum)
Pewter	14 to 20-gauge. 18-gauge is most popular	No annealing required		Easiest metal to spin, machine and solder. Costs several times as much as aluminum—too much to be practical.
Copper	20 to 26-gauge. 23-ga. suitable for most work	1000°—black-red. Quench in water or air cool		Rich golden-red color often desirable. Resists spinning, hence thinner metal specified. Requires frequent annealing
Brass	Same as copper	Same as copper, except air cooling may be preferable	A dry lubricant, such as beeswax, is recom- mended	In general, same as copper, with in- creased tendency to crack and buckle. Requires very frequent annealing



3



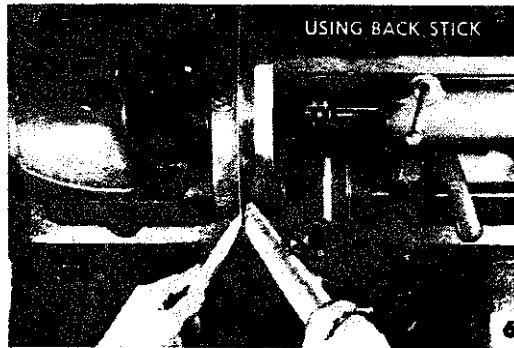
CENTERING  
THE DISK

4



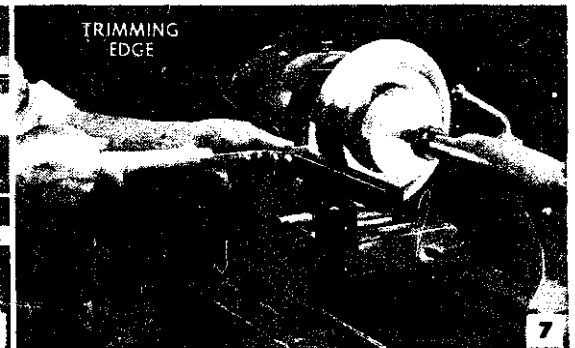
CATCHING  
THE FOOT

5



USING BACK STICK

6

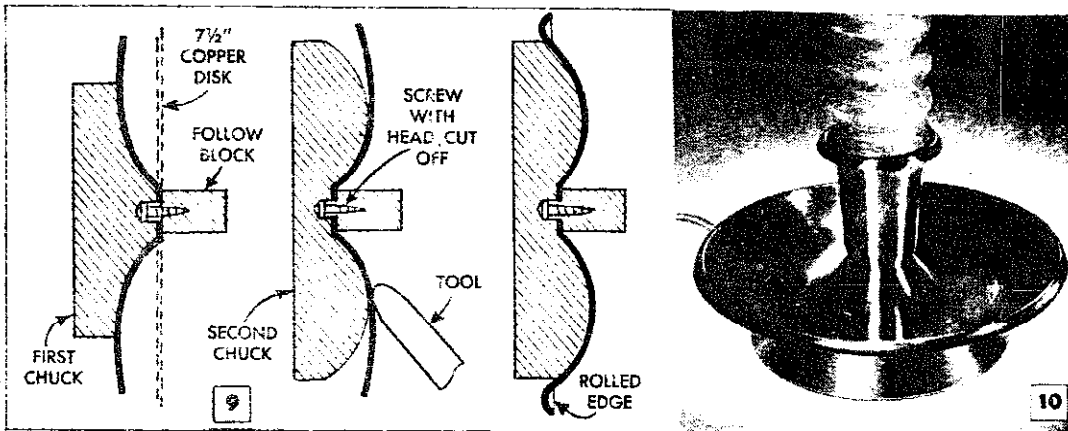
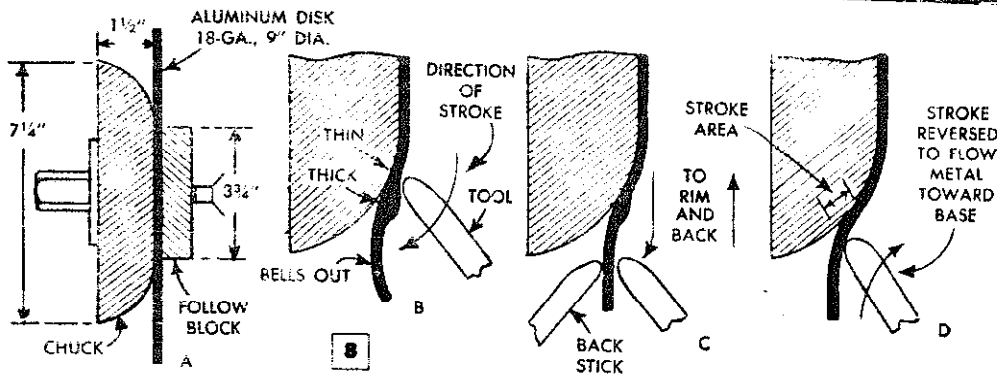


TRIMMING  
EDGE

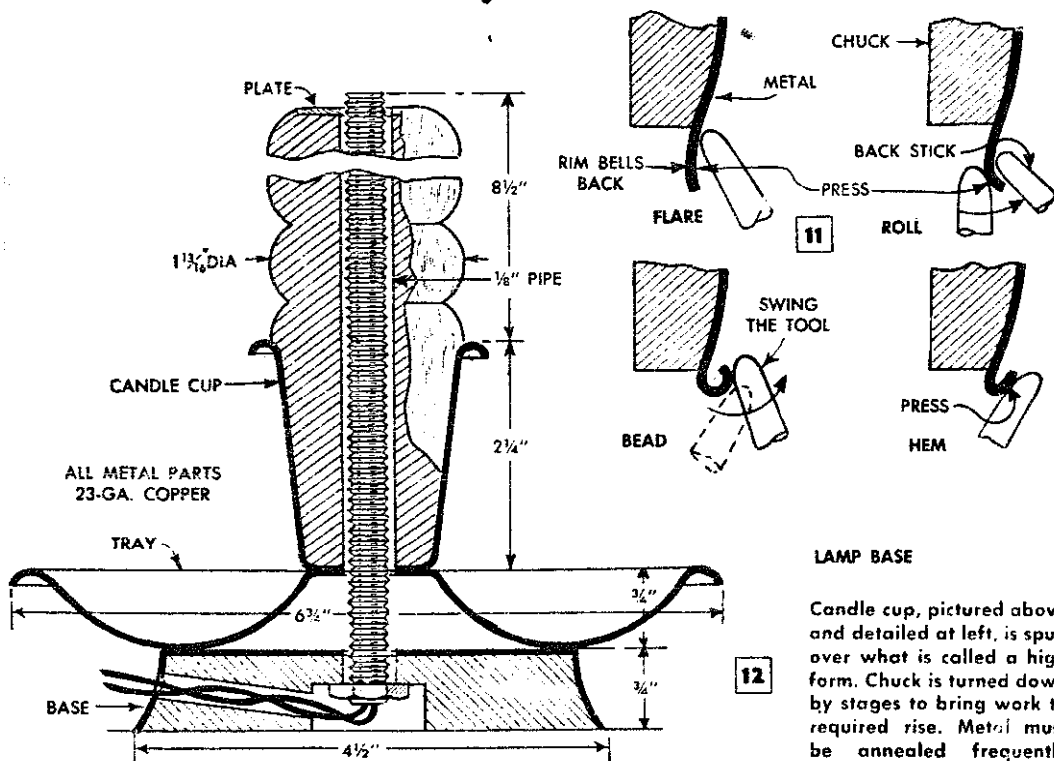
7

items shown you will need beeswax for lubricating the metal and glazing the hardwood chuck over which the metal is formed. Lathe headstock bearings should be in good condition as they must take fairly heavy thrust. If you plan several projects it will pay to purchase the ball-bearing tail center, Fig. 1. The ball-bearing center turns with the work and does not require frequent lubrication to prevent heating as does the nonrotating cup center. However, the latter can be used for occasional jobs. The special tool rest can be purchased ready to use or one can be made to fit your lathe as in Fig. 1. Also, you require the hardwood chuck turned to the form of the finished project. The chuck must be turned and sanded smooth and glazed with beeswax while in the lathe.

**How spinning is done:** Figs. 4 to 7 inclusive show how to set up and spin the popcorn bowl pictured in Fig. 3. Projects such as the bowl usually are referred to as low-form types and require no reverse chucking. After the metal disk has been cut to the required size it is centered between the chuck and the follower as in Fig. 4. Adjust the lathe to give a spindle speed of about 900 r.p.m. This speed can be used for nearly all average spinning projects on a small lathe. Begin by applying pressure at the base of the chuck as in Fig. 5, keeping the point of the tool in a small area not more than 1/2 in. wide. Aluminum begins to spin over the form

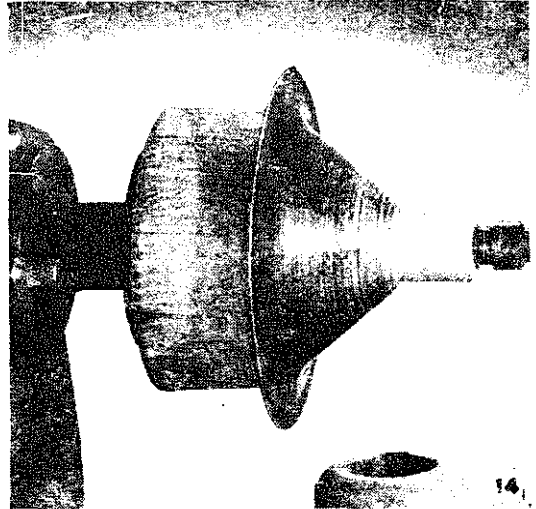
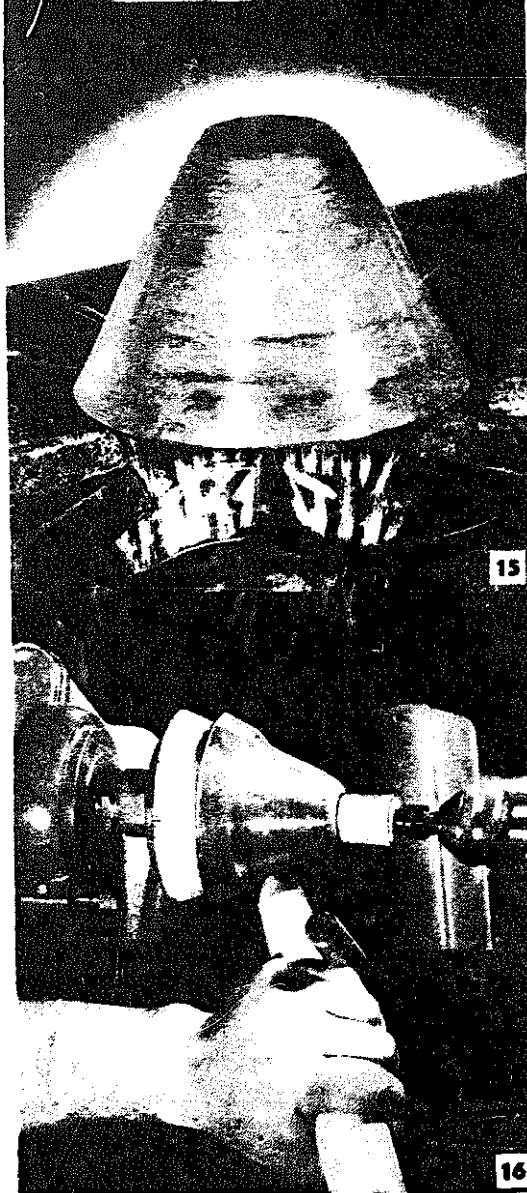
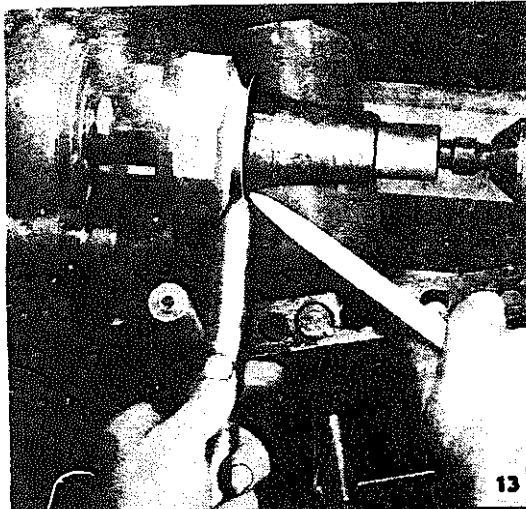


Lamp base in spun copper offers a good example of reverse chucking. Shape requires the use of a first and second chuck. Job is finished with a rolled edge or a bead as shown below. Roll is easiest



LAMP BASE

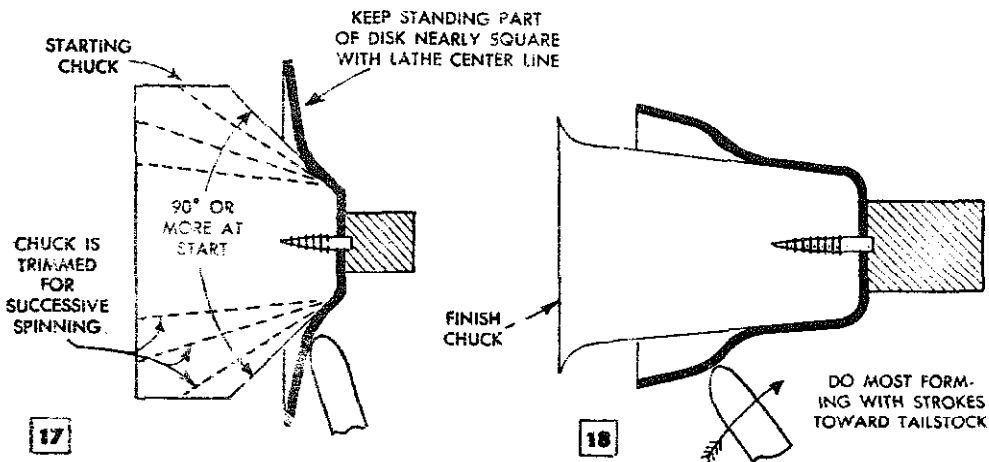
Candle cup, pictured above and detailed at left, is spun over what is called a high form. Chuck is turned down by stages to bring work to required rise. Metal must be annealed frequently



readily when pressure is applied, detail A, Fig. 8, but the rim bells back toward the tailstock as in detail B. Straighten the rim with the back stick as in Fig. 6 and the detail C, Fig. 8. When spinning the next  $\frac{1}{2}$  in. of metal onto the form, make the stroke toward the base of the chuck as in detail D, Fig. 8. From this point on the process repeats. Spin  $\frac{1}{2}$  in. of metal onto the chuck, straighten the standing edge, then continue spinning by  $\frac{1}{2}$ -in. stages until the bowl reaches its full form. As the final step trim the edge as in Fig. 7.

**Edges:** A flared edge forms naturally in the spinning process, Fig. 11, but the edge can be spun tight to the chuck and finished square if desired. The popcorn bowl, Fig. 3, has a flared edge. Applying pressure on the left side of the flare with the back stick will widen it or start a roll as in Fig. 11. This can be carried over to form a bead or pressed flat to form a hem, Fig. 11. Turning the roll over to form a bead requires considerable practice and the process is somewhat difficult to picture clearly in sequence. After the roll has been turned slightly more than that shown in the upper right-hand detail in Fig. 11, it is helpful to file a half-round notch in the end of the forming tool and use this to turn the bead to the full form.

**Copper lamp base:** This project, Figs. 9, 10 and 12 involves reverse chucking of the base and high spinning over a long form to shape the candle cup. Both parts of the base are of copper which must be annealed while spinning. These requirements put the job up in the professional class. Note the spinning characteristics of copper in Fig. 2. The tray requires reverse chucking detailed in the three steps in Fig. 9. With the experience acquired in spinning the popcorn bowl, you won't have any trouble with the lamp base and reverse chucking



the tray will require a little more time, but high-spinning the candle cup takes more skill.

**High forms:** Figs. 13 to 19 inclusive picture the procedure in spinning the candle cup on a high form. It will be noted that the rise of the curved portion of the cup is considerably greater than one third its diameter. This classifies the job as high-form spinning and means that it must begin on a starter chuck as in Fig. 17 and finish as in Fig. 18. In this case the chuck is trimmed for the successive spinning stages. The included angle of the chuck should be at least 90 deg. at the start. Some shapes will require a starting chuck of 120-deg. included angle. Each time the chuck is trimmed it is necessary to spin the metal down to the chuck throughout the full length, as otherwise you may experience trouble with cracking. Fig. 14 shows the first stage nearly complete; Fig. 16 pictures an intermediate stage and Fig. 13 shows the final roll-over being made at the rim. Copper "grows," or "builds," considerably as it is spun and must be held to a uniform stretch by making most of the forming strokes toward the tailstock of the lathe. Even with this precaution it may be necessary to trim the excess metal as in Fig. 19, when the shape nears the final form. Trimming off excess metal relieves stresses to some extent and may help to prevent cracking near the rim, a common trouble when spinning over a high form. Keep the work well lubricated with beeswax as the spinning progresses.

**Annealing:** When spinning copper over any form having even a slight rise it is necessary to anneal frequently. Pressure of the forming tool crystallizes (hardens) copper quickly. In average spinning procedure the change will be noted immediately by the operator due to the sudden



Metal spun over high form tends to stretch. Edge usually must be trimmed before spinning to final shape

increased resistance of the metal. When this occurs stop and anneal. Clean off the beeswax lubricant with turpentine and place the work over a gas burner as in Fig. 15. The temperature of the metal should rise until it "blooms" into colors and then turns black. A few seconds after it blackens remove from the flame and quench in water. In some cases it is advisable to permit the work to air-cool, especially when it is in the final stages of high spinning. The black scale left on the surface will do no harm and is easily removed in the final polishing operations. A quenching solution of five-percent sulphuric acid will keep the metal clean. *Caution:* Sulphuric-acid solution must be handled with care. Do not permit it to come in contact with the skin. Dispose of all unused portions. ★ ★ ★