JAMES THURMAN

james.thurman@unt.edu
www.JamesThurman.com

1155 Union Circle #305100
UNT College of Visual Arts & Design
Denton, TX 76203

# The ULTIMATE COMPILATION of REFERENCES for:

# HINGES

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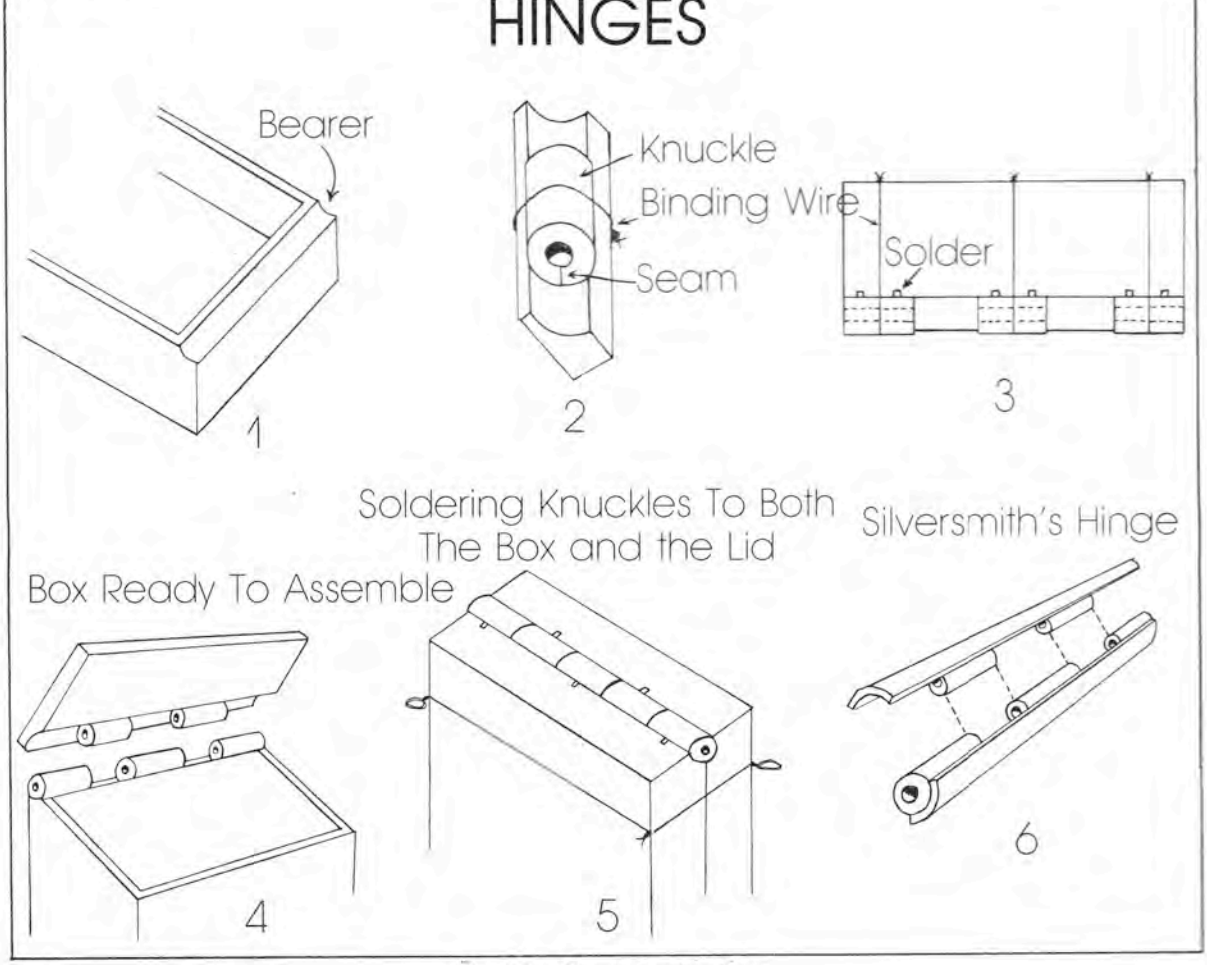



**Fig. 153 Hinge Construction**

# The Theory & Practice of Goldsmithing

Prof. Dr. Erhard Brepohl

TRANSLATED BY Charles Lewton-Brain

EDITED BY Tim McCreight

solder to make a rounded transition. When the branch is completely assembled, it is worked over with a fine graver to heighten the bark texture and provide natural growth patterns at the points where the branches stem off.

ASSEMBLY

Leaves, acorns and branches are assembled and soldered together with the Grandeln setting. When soldering the cap to the main branch, it is advisable to drill a hole into the cap first to insure a proper positioning. The tips of the branches and leaves should be examined to make sure they will not get caught on a wearer's clothing, and soldered down wherever needed. It is sometimes useful to solder balls or ribs of wire onto the back to hold the pieces securely. Use binding wire or soldering investment to secure the many pieces during assembly.

*Fox tooth*

Fox teeth are sometimes set in jewelry, in which case a setting similar to the grandeln is used. The root of the tooth is shortened and glued into a cap. Because the teeth are round, no back plate is used. The tooth is secured with a strong cement like epoxy, perhaps assisted with a rivet.

## 12.3 Movable Connections

When a material as rigid as metal is used on a form as flexible as the human body, some method must be devised to make the one conform to the other. Over the centuries that goldsmiths have been applying their art, thousands of ways have been invented to allow metal parts to twist, slide, rotate, hinge and swivel. A complete list would be impossible to assemble, but it is useful to look at basic groups such as the following:



### 12.3.1 RING CONNECTIONS

This is perhaps the most basic of all movable connections. The examples in figure 12.15 show some of the ways that rings can be used to link two solid pieces in a way that allows them to move. Two rings are connected at right angles to each other (12.15a) or two stationary rings are linked by a third ring at right angles (12.15b and c). The connection illutrated in figure 12.15d shows a version of a hinge that is an extension of the preceding arrangement. In this case the travel or play of the movement is limited by the joining link. When compound or multiple units are assembled, a chain mail is formed (12.15e).

### 12.3.2 HINGES

As with every other family of movable parts, hinges exist in hundreds or perhaps thousands of variations. The concept and terminology will be introduced here by illustrating a basic version, but readers are advised to apply this information to their own explorations.

Hinges are usually made by soldering lengths of tubing, called knuckles, onto the parts to be joined. The tubing can be of any size relative to the rest of the piece, depending on design considerations.

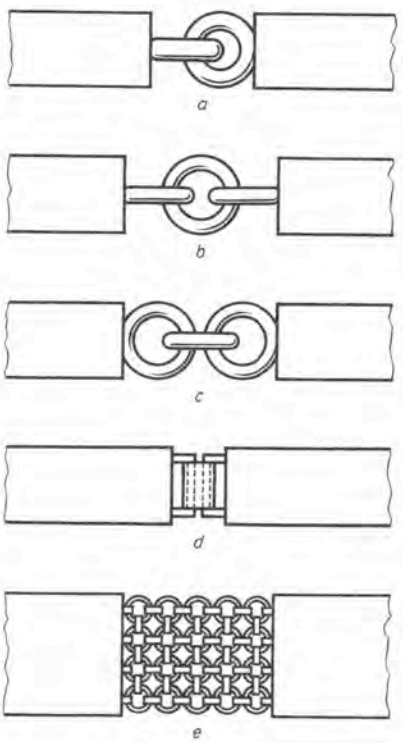



*Figure. 12.15*
*Simple ring connections.*
*a) ring pair, b & c) three ring connection, d) hinge-joint catch, e) chain mail connection.*

Generally the wall thickness should be about one-fourth the inside diameter, which is to say, relatively thick. Not only will a heavy tube be easier to solder, but the hinge will stand up to years of wear and tear.

Except for a few special cases, it is customary to make hinges with an uneven number of knuckles, (3, 5, 7, etc.). When making a three part hinge joint, the middle section can be larger than the outer two parts. The middle section is soldered to the lid, the outer pieces to the main piece, on a box for example.

In order to operate smoothly, the tolerances in a hinge must be tight. That is, the parts need to fit together closely in perfect alignment. One way to achieve this is to solder all the pieces into place on both base and lid in the same operation. This has the advantage of insuring correct fit but the disadvantage that elements that are supposed to move may become soldered fast to one another.

The alternate arrangement, in which parts are soldered onto the lid in an operation independent of a similar operation on the base has the advantage of low risk but makes it easier for pieces to be out of alignment. Both methods are widely used and both will be presented here with the thought that each goldsmith can choose a favorite method.

*Method 1*

Prepare a groove or bearing in the parts to be joined, for convenience here called lid and box. The groove should span the two units equally and should be a perfect fit for the tubing that will make the hinge.

A hinge or joint file is made just for this purpose: it looks at first glance like a flat needle file that has no teeth. In fact the broad surfaces are plain, but the smaller edges are half round and cut with fine teeth. These will cut a parallel groove, unlike a tapered round file, which will of course cut an irregular groove depending on which part of the file actually does the cutting.

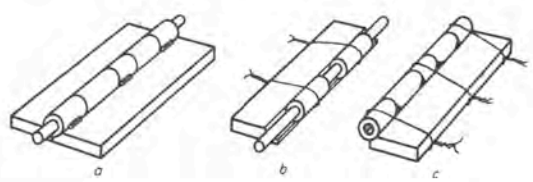



*Figure. 12.16*
*Soldering the movable hinge-joints.*
*a) soldering of the entire joint, b) and c) soldering of the parts of both connection sides.*

The tubing is cleaned and cut into the desired number of parts. It is critical that the ends of each knuckle are flat and at a right angle to the axis of the tube. A tube cutting jig is highly recommended because it insures a clean straight edge. Even when using a jig, be careful to use a small sawblade and to remove any bur that clings to the tube.

The tubing pieces are slid onto a lightly oiled piece of steel wire or a graphite rod (pencil lead), and the hinge unit is set into place in the fluxed groove, (figure 12.16a). A small clean piece of solder is set onto each knuckle, placed alternately so that if knuckles 1, 3 and 5 are attached to the box, numbers 2 and 4 are attached to the lid.

The piece is heated, concentrating first on one side, for instance the box. When the solder has flowed on those three knuckles, direct the heat to the lid and solder those pieces. If the solder only flows partially but is enough to tack the pieces into position, cool the piece, withdraw the wire and separate the two parts. Insert the wire through the knuckles in one unit to keep them in alignment and resolder to guarantee a solid joint. Repeat on the other unit if necessary.

*Method 2*

Prepare a groove (or bearing) as described above. Clean a length of tubing and mark it off into the desired number of knuckles as before, but this time do not saw each length off. Instead, use a saw to cut a line 7/8 of the way through at each mark. If the piece is to attach to the base, leave knuckles 1, 3 and 5, but turn the saw and cut away the pieces of tubing that fall between those three, leaving a small piece of the tube as a bridge that holds the three pieces at exactly the correct distance from each other.

This unit is then set into the groove on the box where it can be held in position with binding wire if necessary. Align the tube so that the bridging elements are facing out, away from the box. This will

allow them to be easily reached at the next step. Apply a small piece of solder at the point of contact where each tube touches the box and heat until the solder flows.

When the soldering is completed and the work pickled, the thin strip of metal that previously held each knuckle is sawn away, using care to insure that the end of each knuckle remains square. Pieces of tubing are cut to fit snugly into the openings that remain, which are marked with a scribe onto the lid. The tubing pieces are slid onto a steel rod and fastened in place for soldering. Of course it is also possible to repeat the same trick and saw out the midsection of a length of tubing that includes the remaining two knuckles.

*Spring loaded hinge*

This type of hinge, shown in figure 12.17 is frequently seen in cigarette cases and novelty containers like pill boxes and compacts. The hinge is constructed of knuckles as described above, except in this case an even number is used. This means that one end knuckle is attached to the lid and the other end piece is attached to the base, a necessary arrangement for this hinge.

After assembly, the hinge is held together not with a conventional pin, but by inserting a flat strip of spring steel through the hinge. Depending on the purpose and scale of the piece, several pieces of spring can be laid on top of each other. The springs can often be retrieved from broken watches and clocks, though care must be used when pulling springs from those mechanism because they are under tremendous pressure.

The strip is cut a little longer than the hinge and slid into place where it is wedged into place at one end with a tapered plug; see figure 12.17. If the spring lays flat when attached (as in the upper illustration) the lid will be under tension when the hinge is opened and will snap closed. It is also possible to "load" the spring by grasping the projecting end with pliers and rotating the strip a full turn. In this case the lid will be under pressure to pop up, assuming you've rotated the correct direction. This is especially useful in a box fitted with a tight clasp. When the mechanism is proven to work correctly, saw the springs and plugs slightly oversize, tap them once more to insure a tight fit, and file them flush.

*Cradle hinge*

In this instance a thick bearing is soldered into position rather than cut from the existing material. It has several uses, but will be illustrated in a hollow hinged bracelet. Start by making two tubes that slide together, one into the other like a telescope. Both should be thick walled.

Set the smaller tubing aside and turn attention to the bracelet, preparing a hole that will fit the larger diameter tubing. This should be in contact with the outer wall of the bracelet – if the tubing diameter is smaller than the thickness of the bracelet, the resulting opening into the hollow center must be capped, both for strength and to make an attractive hinge. Fold over a piece of sheet metal and cut away enough metal to allow it to be put into position as shown in (figure 12.18a). Solder it there, being certain that no solder flows between the faces of the two sides.

File the seat, including the piece just inserted, so the larger tube makes a tight fit into position as shown in figure 12.18b. This tube, which will become the bearing for the hinge, is soldered into place.

The bracelet pieces are separated by sawing through the tubing in two places, at the top of the tube where it makes the tangent of the bracelet, and directly opposite that point, where the tube is closest to the center of the bracelet. The protruding parts of the U-shaped piece are cut off and trimmed neatly by filing. The result of all this is that the previously open ends of the bangle are each closed with a half section of tubing and a straight strip of metal, perhaps evident in figure 12.18b.

A knuckle equal to one-third the width of the bracelet is cut from the smaller diameter tube and soldered into place in the center of the bearing. Because the two tubes made a perfect fit originally, this knuckle has no where to go except to fall neatly into the bearing tube. It is soldered there, with a result that will look like the drawing at figure 12.18c.

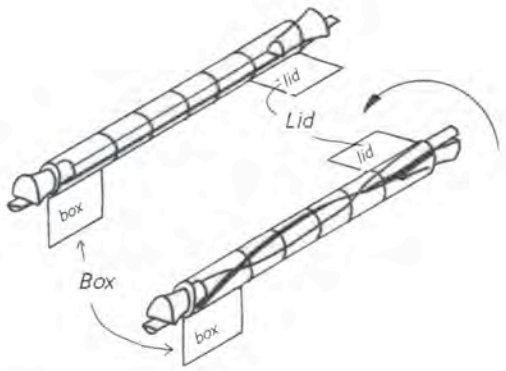



*Figure. 12.17*
*Hinge with spring wire and wedge.*
*a) At rest, b) under tension.*

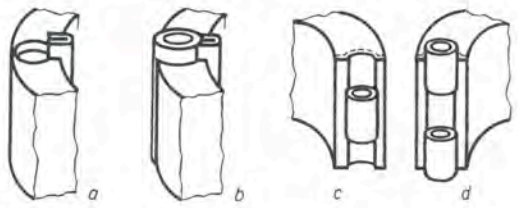



*Figure. 12.18*
*Soldering of the counter hinge.*
*a) Inserting of the closing metal to adjust for the thickness of the bangle, b) soldering of the outer hinge, c) middle section – movable hinge in its hinge shell, d) outer movable hinge.*

*Figure. 12.19*
*Bayonet linkage.*

Lay the bracelet pieces together and mark the location of the soldered tubing onto the second bearing. Cut two additional knuckles from the smaller diameter tubing, apply flux, and solder them into position as indicated by the marks just made (figure 12.18d). Some people like to tack the pieces, lifting the torch just as the solder starts to flow. If the fit checks out, reflux the joint and heat it until the solder flows throughout. If necessary the protruding ends of the tubing are filed off flush with the side walls of the bracelet. A temporary pin can be inserted into the hinge to facilitate finishing.

### 12.3.3 BARRETTE LINKAGE

This linkage is seen most often in high end work. The possible radius of rotation is limited on one side of the shape by the wedge (which is inserted into the next unit) and by the size of the space between the units. The links can assume almost any shape, but usually they are closed four sided cross sections or have inner walls that are open as a U-shaped cross section (figure 12.19).

Create a square or rectangular tube by drawing a round tube through the appropriate drawplate while using a core of copper or steel. If possible, arrange that the seam lie on a corner. To make a bracelet, start by bending this stock around a bracelet mandrel or stake. The links are sawn apart and the core material is etched out.

If the links have a U-shaped cross section, a square or rectangular tube is made in the same way, but using a copper core. The seam is positioned on the side what will later be the inside of the bracelet; the form does not need to be soldered closed. Bend the square tubing around a bracelet mandrel then file away the inside surface until the core is laid bare. The individual links are sawn apart and the core pieces can be pulled out. This open back economizes on material but the links are not as comfortable against the skin.

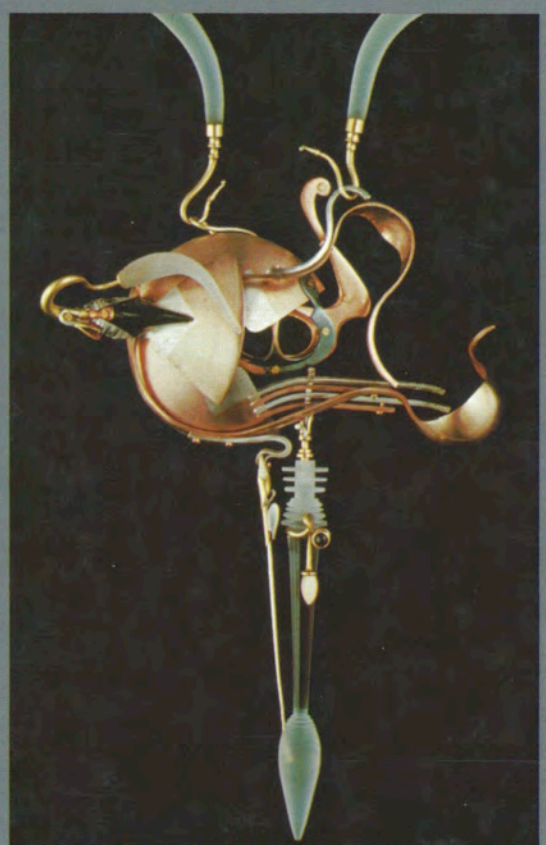
File both ends of each link at a slight angle to allow flexibility between the links. Prepare sections of square wire (or rectangular stock) by filing each piece to the shape of a wedge. Solder a unit into one side of each link. This wedge is slid into the adjoining link and drilled through. After completing the links, a length of wire is fed through the holes and the links are riveted together as shown in figure 12.19.

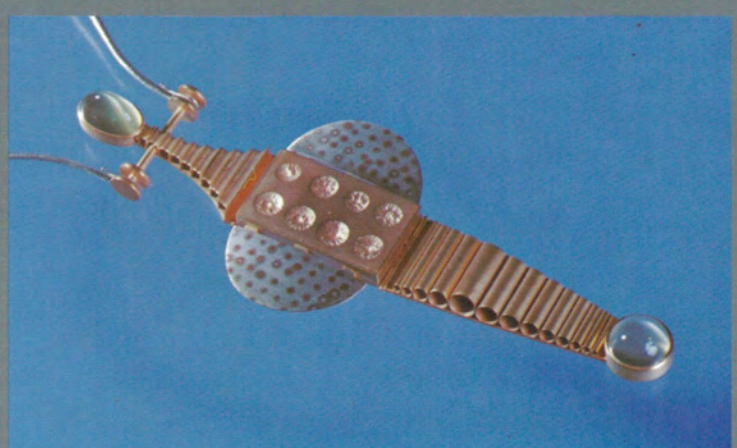
### 12.3.4 STUD CONNECTIONS

This linkage system is a variation of the barrette joint described above. Because the links are designed for sideways movement their mobility in use is very good. The links are made as for the barrette linkage, using square, rectangular or U-shaped cross sections. Cut the links, leaving extra material for the joint.

One side of every link is filed half round and on the other side a matching indentation is filed out to cre-

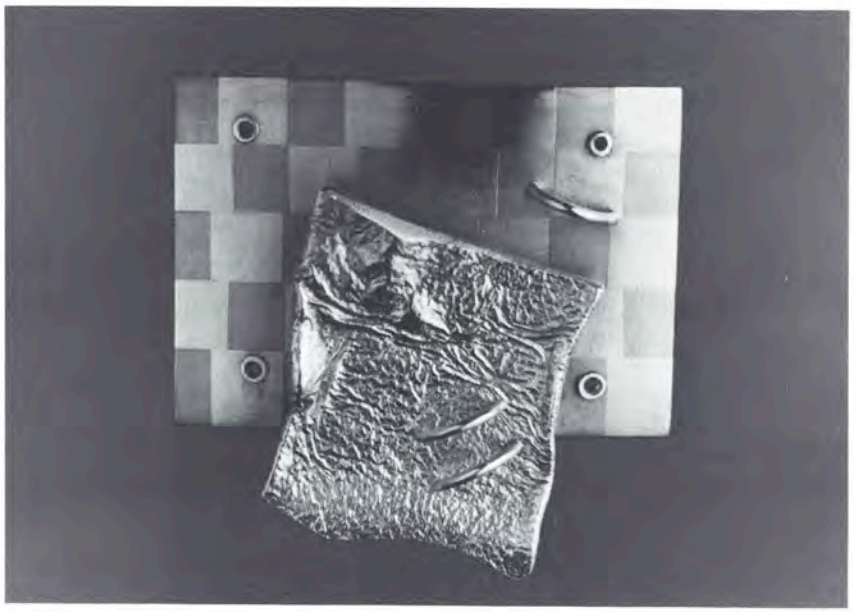
# JEWELRY





## CONTEMPORARY DESIGN AND TECHNIQUE

*Chuck Evans*

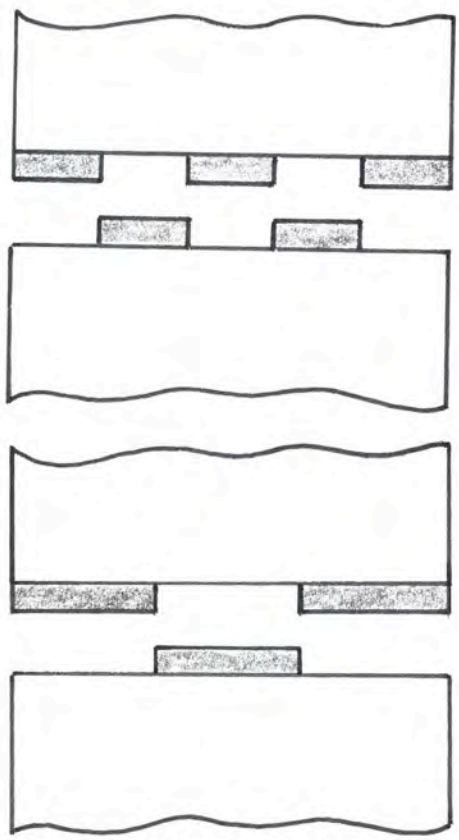


**7–19 Lisa D'Agostino.** *Pin of sterling and copper; inlaid, torch textured, and constructed with tube rivets. Courtesy of the artist. Photograph by Peter Krumhardt.*

## HINGES

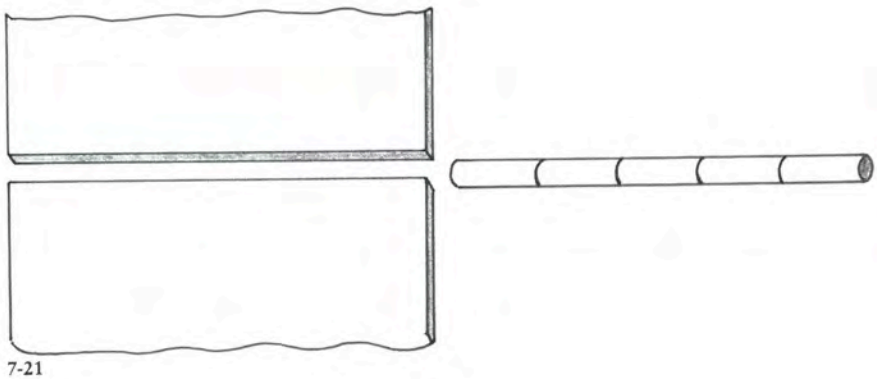
Articulation is often an important consideration in jewelry design. Both function and aesthetics are the major components underlying this consideration in determining the most suitable mechanism to join the various elements that might have to pivot or swing. Hinge devices clearly offer an excellent answer to the question of function. Aesthetically, the same solution may be proper, depending upon how creatively its application is approached. While the primary emphasis here will be placed on the hinging of jewelry pieces, the basic processes are applicable to other metal forms. Once familiar with the basics and construction of a simple hinge, the novice can experiment and explore the challenges of creatively integrating hinging devices in jewelry work.

Hinges are generally composed of several lengths of tubing with a pin or rod extending through them that serves as a joint or pivot point. Alternate tubes are soldered to the two pieces being joined. Figure 7–20 illustrates the soldering sequence of three- and five-element hinges. The following step-by-step description details the assembly of a simple five-element hinge used to join two pieces of flat sheet metal. Given these few points, the remaining techniques in this section will be easy to master.



**7–20** *Sequence in which a three and five element hinge is soldered.*

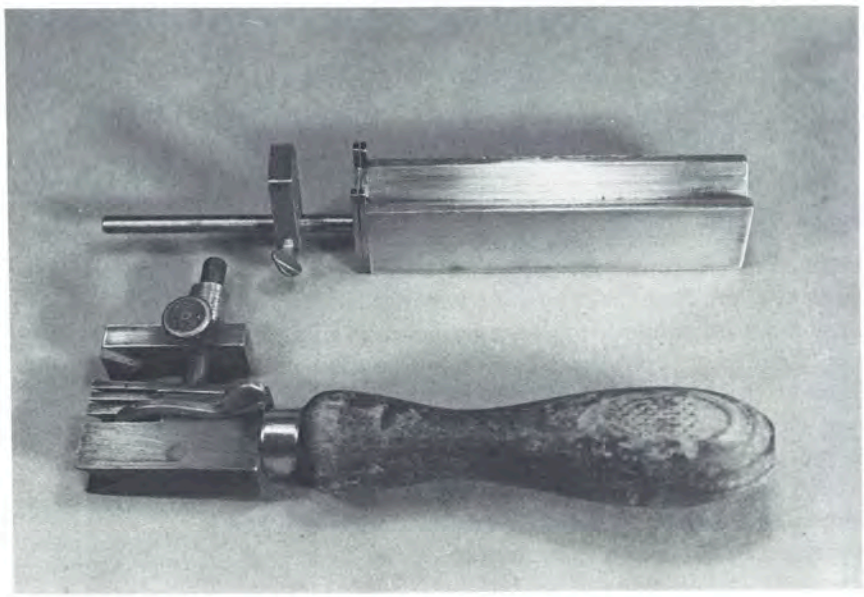
7–21 *Joining edges are filed straight.*
7–22 *Tubes cut to the appropriate lengths.*



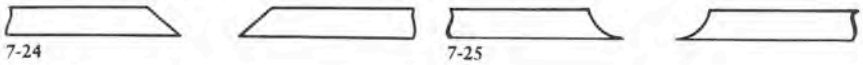
7-21

7-22

7–23 *Tube cutting jigs.*

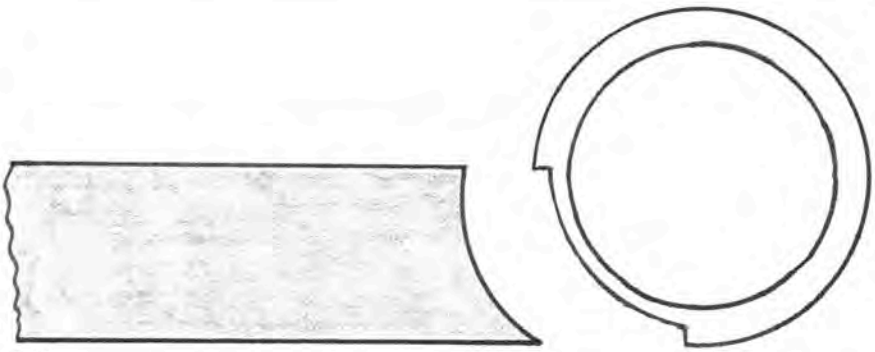


1 File the two joint edges straight and flat as if preparing a butt joint (figure 7–21). With strength and aesthetic considerations in mind, select the size tubing to be used.
2 Considering the length of the joint, measure the tubing in order to attain five equal pieces whose combined lengths correspond to the length of the joint. Cut the tube sections to the appropriate length with a fine blade (figure 7–22). A tube-cutting jig can be used to hold the tubing in alignment while cutting (figure 7–23). The jig can also be used to hold the sections while filing the ends square. Remove any burrs that might result from sawing or filing.
3 File the edges of the joining pieces at an angle corresponding closely to that of the tube sides (figure 7–24). On large pieces where thicker metal might be joined, the edges should be filed concave to correspond precisely to the shape of the tube (figure 7–25). This provides a stronger solder joint. With a file, slightly undercut the bottom edge of each section's ends (figure 7–26). File only that portion of the edge that might be subject to solder flow. An undercut


7-24


7-25

7–24 *Angled joining edges.*
7–25 *Concave joining edges.*
7–26 *Tube edge beveled at the joint to prevent solder buildup.*

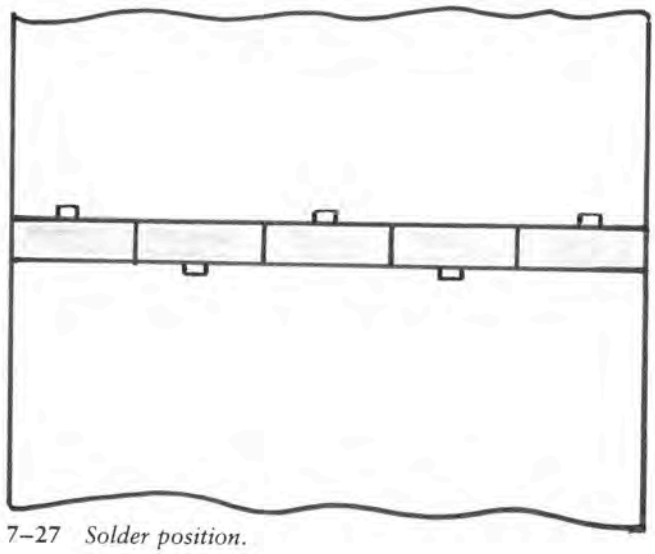

7-26

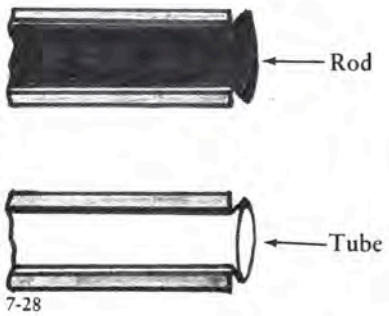
prevents a possible solder buildup along this area, which would make final fitting difficult.

4 Maintenance of the correct relationship of the tube sections to the workpiece is perhaps the hinge maker's biggest stumbling block. In this instance, a flat soldering surface and a steel aligning pin will help ease the task. Prepare a steel pin slightly longer than the hinge and of a diameter corresponding to that of the inner diameter of the hinge. Binding wire, nails, coat hangers, or old drill bits can be used. The alignment pin must be straight. Heat the pin and allow it to air cool. Repeat this several times until the pin is well oxidized. The oxidized surface will resist solder that might inadvertently spill over. Slide the tubes into their correct sequence over the steel pin and set the hinge alongside the workpiece on a clean, flat firebrick or block of charcoal. Be sure all elements are sitting flat and flush against each respective unit.

5 At this point the hinge sections will only be tack-soldered in place. Set a tiny piece of solder by each tube (figure 7–27). Do not saturate the entire joint with flux. Add just a bit at the points to be tacked. Direct the soldering flame on one section at a time. Remove the heat just as solder begins to flow. Keep in mind that the objective here is to tack the pieces in place and not to have solder flow completely through the joint. A complete flow can result in bonding adjacent tubes.

6 After tacking, let the piece air cool and remove the pin. It may be necessary to use pliers to pull the pin free. Removal is sometimes made easier by first soak-


7–27 *Solder position.*



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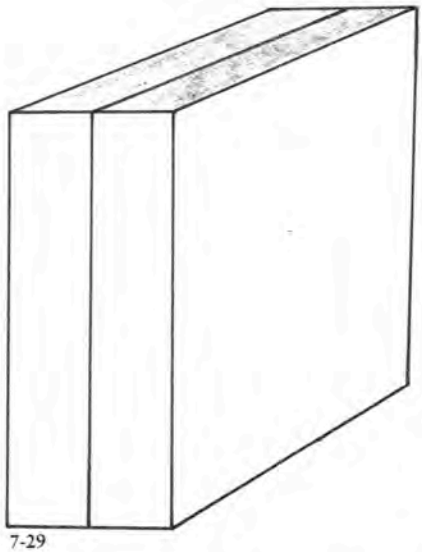
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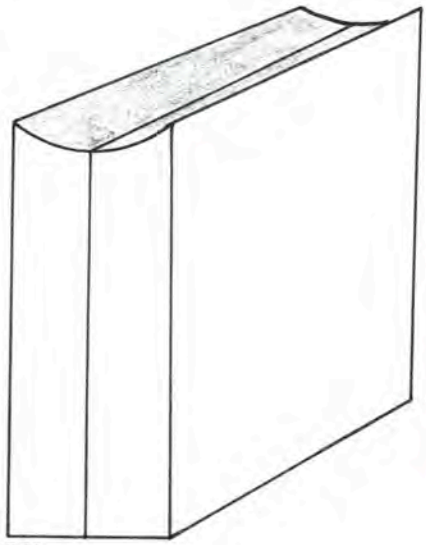

7-30

7–28 *Hinge pin of tubing or rod.*
7–29 *Hinge plates glued back to back.*
7–30 *Glued plates grooved.*

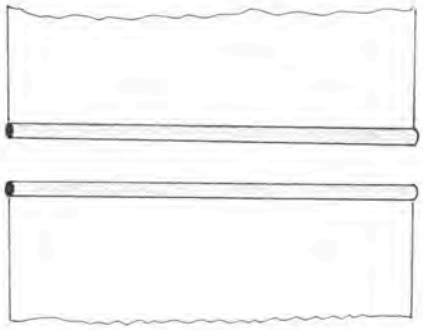
ing the work in hot water. The piece can now be pickled.

7 Replace the pin through one side. Flux each tube, add another bit of solder, and flow each joint separately. Reuse of the steel pin assures alignment as the individual joints reflow. Repeat this step on the opposite side. Remove the pin and pickle the work.
8 There are several methods of joining the two halves. Two possibilities are presented (figure 7–28). The pin should fit snugly, be visually integrated, and be removable if repairs are needed. Finish by filing and emerying excess metal from the pin and tube ends.

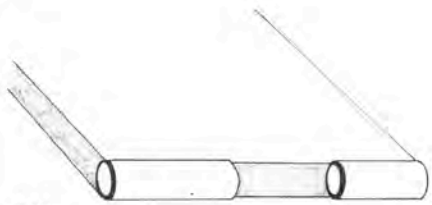
Rather than placing the hinge elements directly against the workpiece, the hinge may be constructed as a separate unit and then soldered or riveted to the jewelry. This type hinging is commonly used by silversmiths and generally constructed of thick sheet and heavy tubing. For our purposes, commercial tubing suffices. Preparation of the joining edges is as follows:

1 Using two pieces of 10- to 16-gauge sheet metal, file the joining edges straight and flat. Glue the two pieces back to back (figure 7–29). Five-minute epoxy works well and will separate when heated.
2 Place the metal between two pieces of wood in the jaws of a vise. The wood will protect the metal from being marred by the jaws. With the pieces secured, file a groove along the top edges (figure 7–30). The con-

7-31



7-32



7-33

7–31 *Joining edges prepared to accept tubes.*
7–32 *Single length of tubing soldered to each half.*
7–33 *Center third cut away.*

cave groove should correspond to the curve of the tubing being used.

3 In order to maintain a uniform groove, a round parallel file should be used. Tapered files will usually cause an uneven or tapered groove. When filing, occasionally check the groove against the tubing. After forming the groove, remove the plates from the vise and heat the pieces to separate them and burn off the remaining epoxy.
4 The individual tube sections may now be prepared and attached as outlined earlier in steps 4 through 8. Joining of the finished hinge may be made by soldering or riveting it into or against the jewelry piece.

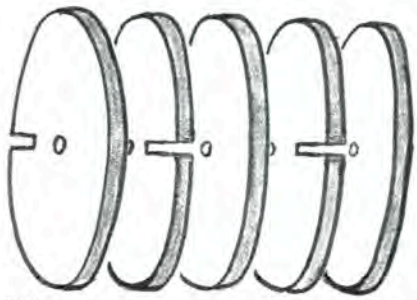
Construction of a simple three-knuckle hinge on flat sheet metal can be relatively easy. The method discussed here is admittedly a little wasteful of materials, but it eliminates the need for an alignment pin.

1 File the joining sheet metal edges as shown in figure 7–31 and solder a single piece of tubing along the entire length of each edge (figure 7–32). Solder over a clean, flat firebrick or pad.
2 Carefully cut away the center third of one tube with a fine saw blade. Square up the cutaway edges and solder joint with a flat needle file (figure 7–33).
3 Set the hinge sides together and scribe marks from the cut section onto the uncut tube. The outer thirds of the uncut tube can carefully be cut away. Cut along

7–34 *Instead of using tubes, discs are slotted and soldered to alternate sides. A hinge pin and tube spacers may be used to align this hinge.*

7–35 *To add visual interest in the hinged area, saw cuts can be made to remove material across the front of each soldered section.*

7–36 *Saw cuts give the illusion of multiple sections within each element of a hinge; i.e., a hinge composed of five tube sections will appear to be composed of twenty smaller elements when saw cuts are made into the finished hinge. This illustration shows one tube section.*



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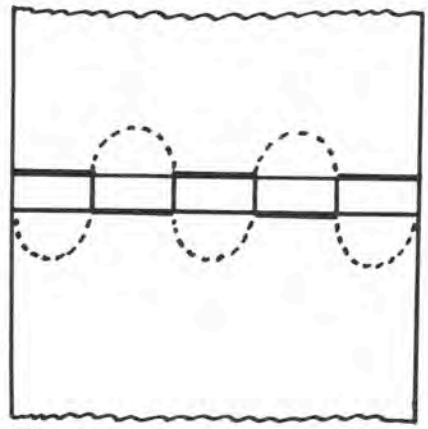

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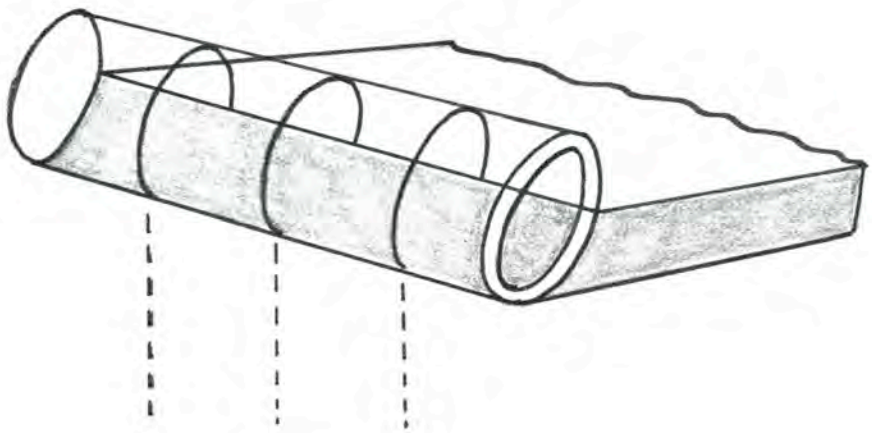

Saw cuts

7-36

the inside of the marks and finish by squaring the edges with the file. It is important to slightly undercut the second tube and carefully trial fit the pieces as filing progresses. Continue filing and trial fitting until the two sides slide together. Install the pivot pin and finish as discussed earlier.

Considering the time and effort involved in creating hinges, they should be used as effectively as possible. With planning they will appear as integrated elements in the total work, not as afterthoughts. An understanding of the fundamental construction techniques allows the jeweler to embellish an otherwise plain mechanism. Figures 7–34, 7–35, and 7–36 illustrate several possibilities.

# Hinges and Hinge-Based Catches for Jewelers and Goldsmiths

Charles Lewton-Brain

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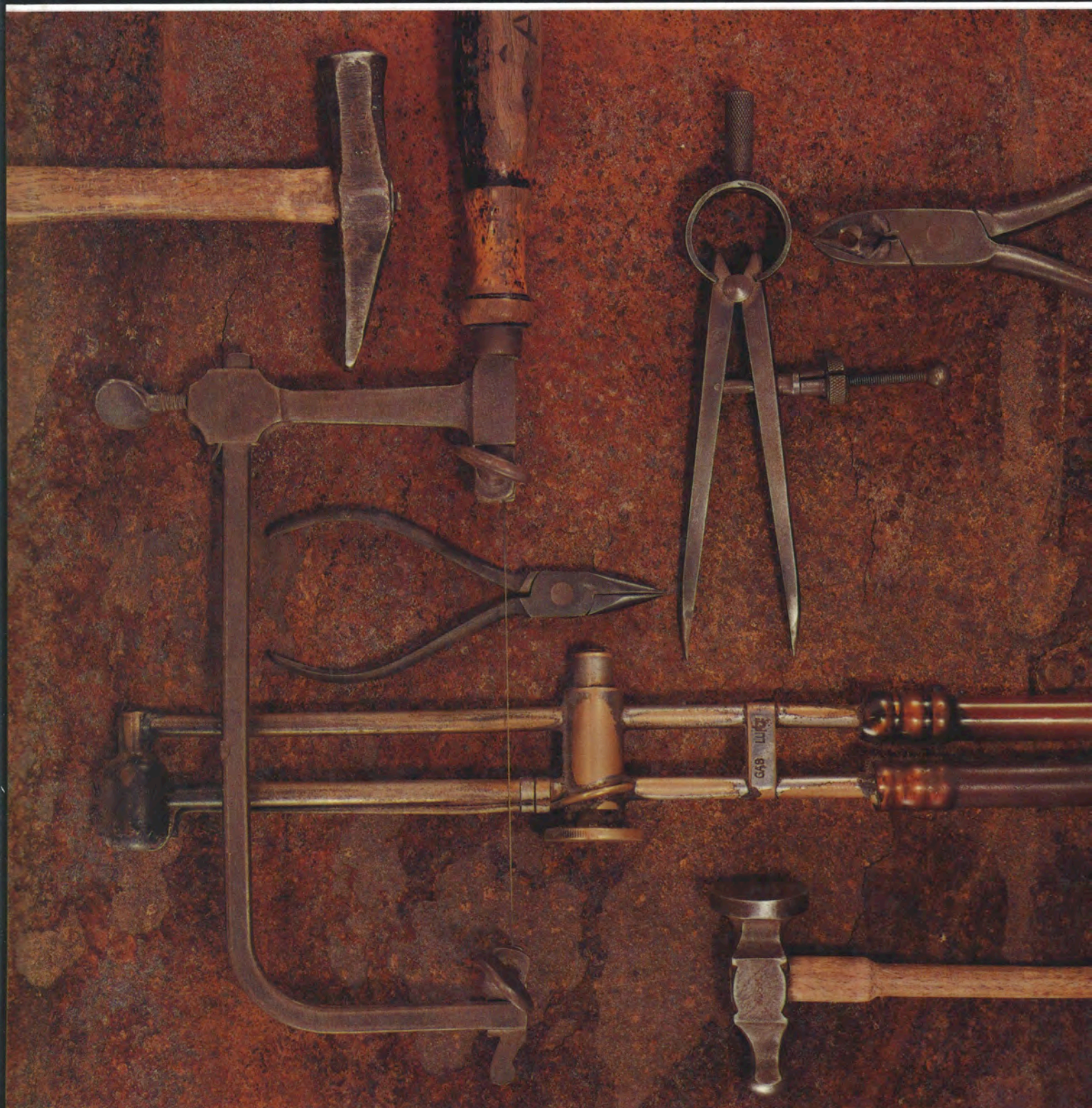
# Practical jewelry making

Loosli / Merz / Schaffner

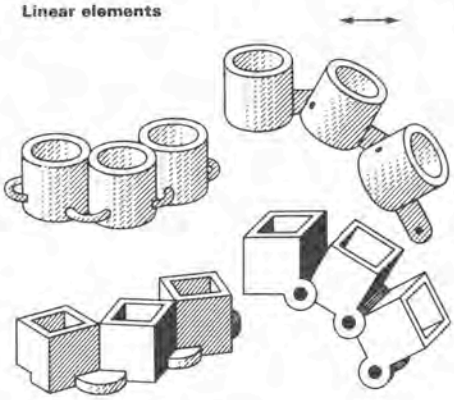


UBOS / SCRIPTAR

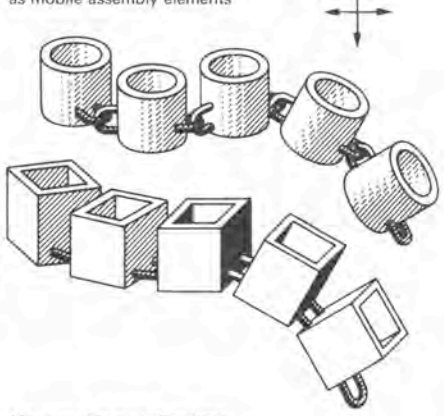
# 31 Joints and linkages

as mobile assembly elements

**Linear elements**



Movement in one direction



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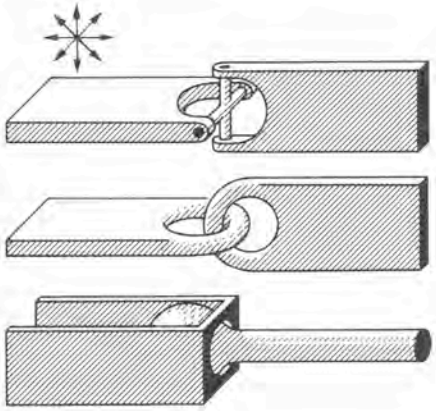
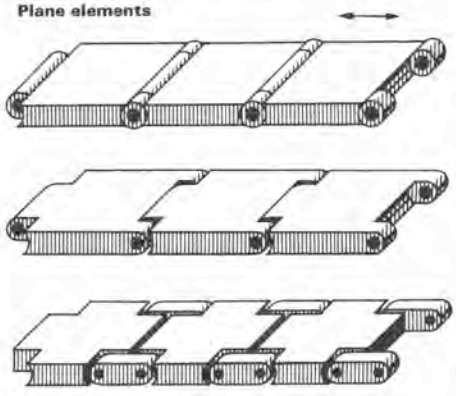
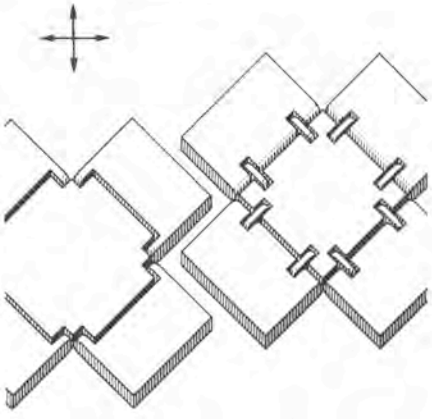


Movement in several directions

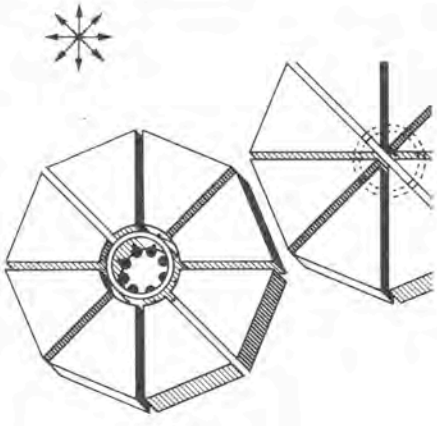
**Plane elements**



Movement in one direction



Movement in two directions

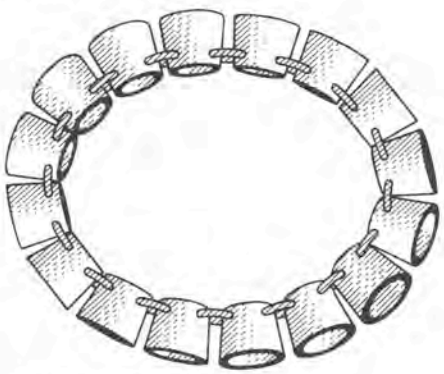


Movement in several directions

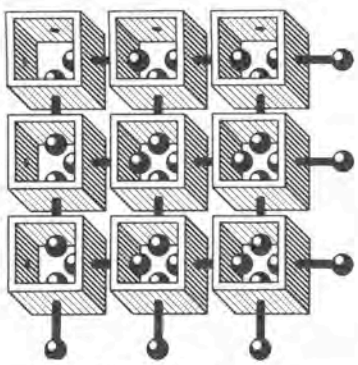
Observe:

- the direction of movement of the joint and the most appropriate hinge type
- the range of movement of the joint and the requisite angular opening (uniformity)
- the correct thickness of the hinge (not too thin!) in relation to the stresses which it will have to bear
- the fitting of the hinge pin (neither too loose nor too tight)
- the optical effect of the joints in relation to the appearance of the piece of jewelry
- the use of linkages as decorative elements (creative possibilities)

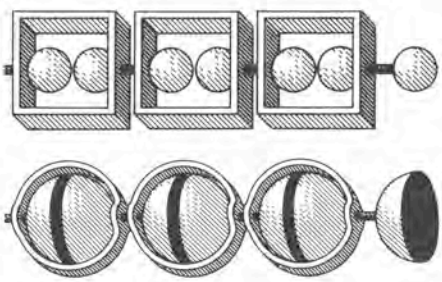
**Possibilities of creation**



Linkages forming a circle



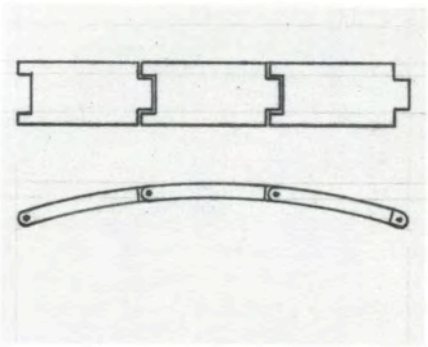
Linkages forming a level surface

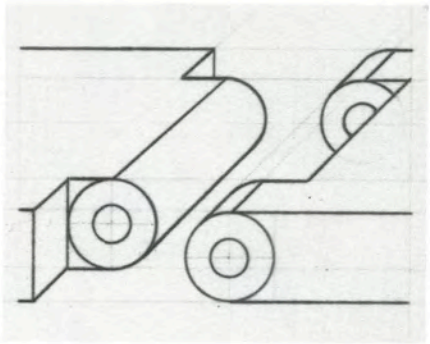


Linkages as decorative features

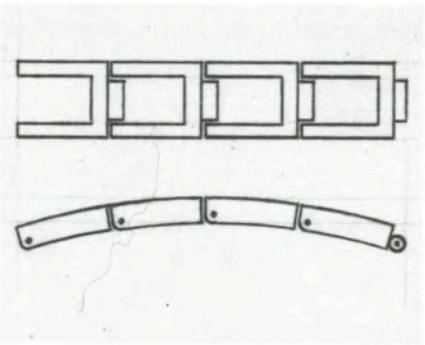
# 31 Joints and linkages

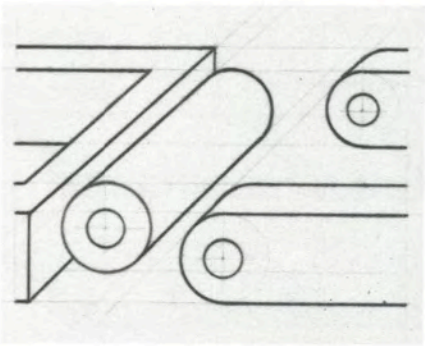
Joint with three-part knuckle



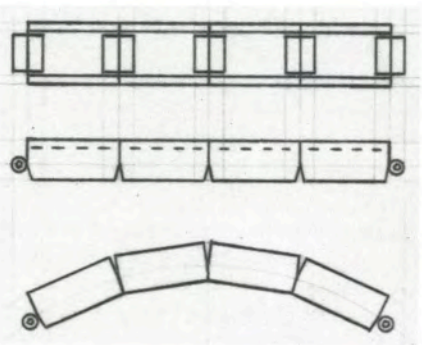


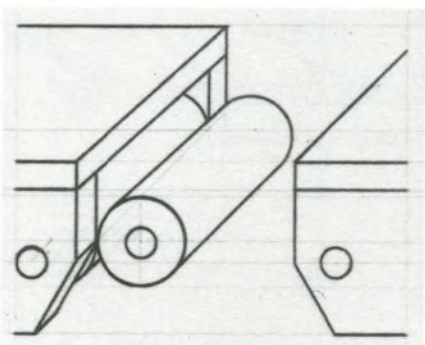
Joint with knuckle and two cheeks



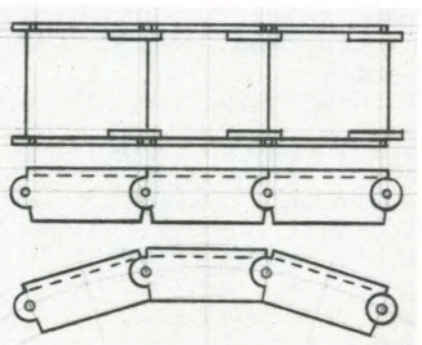


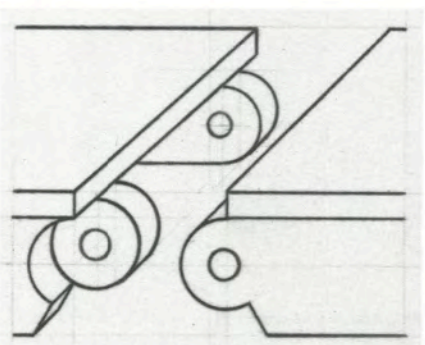
Joint with double knuckle and cheeks



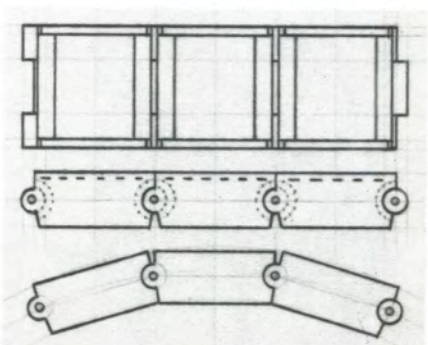


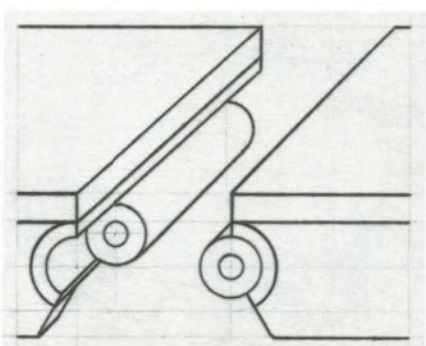
Simple cheek-type joint





Counter-knuckle joint





# COMPLETE METALSMITH

Tim McCreight

Brynmorgen Press

# Hinge-Based Catches

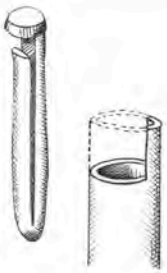
## Hinges as Clasps

> This family of hinges, most often used on bracelets, consists of a standard hinge with three or five knuckles, usually made of tubing with an inside diameter of about 1–3 mm. The clasp is undone by pulling the hinge pin out, either all the way, or enough to clear all but one knuckle. To prevent the pin from being lost, it is attached in some way.

> When the bracelet has several strands, build the clasps in two pieces of scored and folded sheet metal. This will provide support, solid soldering contact, and alignment.

> When attaching the pin with a chain, see that it is long enough to allow the pin to be removed, but only that. Excess chain is distracting and likely to catch on clothing.

### *Folded Tab*

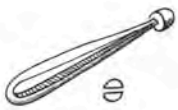


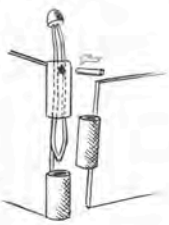
1. Make a three-part hinge.
2. Select half-round wire with a diameter equal to the inside diameter of the tube. Fold it in half, flat sides inward, so that one arm equals the length of the hinge and the other is a little shorter. Solder a cap or bezel onto the longer end.
3. Saw off the top section of one of the outer tubes so that all that remains is a small tab.
4. After all finishing is complete, insert the hinge pin and fold the tab over at a right angle. This will prevent the pin from coming out

### Applied Tab

Follow the steps above, but in this case, use a round wire that fits neatly into the hinge. File away about a third for a portion equal to two of the knuckles. Cut a notch in the top section of hinge to position a small length of square wire. As a final step, insert the pin and solder the cross-brace in place. This will make it impossible for the pin to come out.

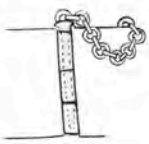
### Friction with Pin





1. Make a three-part hinge, using tubes that are at least 2.5 mm inside diameter.
2. Select a small gauge round wire that will fit into the tube when doubled over. Fold a section in half and snip to a length just a bit shorter than the hinge. Solder a cap or bezel onto the two ends.
3. Drill a small hole through the top knuckle, and prepare a bit of wire that makes a snug fit.
4. Insert the pin through the hinge, then slide the short wire into place so it rests between the legs of the hinge pin. Solder it in place.
5. Adjust the bowing shape of the pin so that it makes a friction fit inside the tube.

### Attached Chain



Use a short length of chain to safely attach a removable hinge pin to a jewelry piece. Keep the chain just long enough to allow the pin to slide out—too much risks snagging. The chain can be handmade or commercial, as best suits the piece.

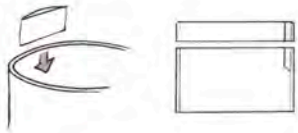
### Providing a Base

When the bracelet has many strands, build the clasp in a bent piece of sheet metal. This will provide stability, better solder contact, and alignment.

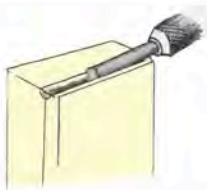
# Hinges

## Hingemaking Tips

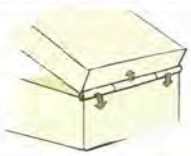
› If the material is too thin to take the stress of a hinge, solder bearers either inside or out. This is especially important for round or oval containers.



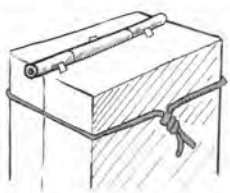
› Prepare a seat (trough) in which the knuckles, or hinge sections, will lie. Care in this step is important. A straight round file is better than a tapered one. A joint file is made for this. Make a scraper from a ground-off drill bit and slide it to scrape away tiny shavings for a perfect fit.



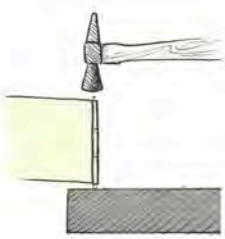
› Measure and cut the knuckles, keeping the ends square. If only three knuckles are used, the single piece goes on the lid and may be slightly longer than the other two.



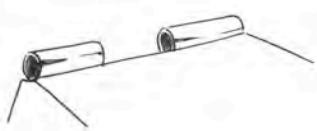
› Flux the groove and lay the knuckles into position. Some jewelers slide the knuckles onto a snug-fitting oiled steel pin (nail, binding wire, etc.) to guarantee that they stay in a straight line. Tie with binding wire if necessary. Place small pieces of solder so they touch both the knuckles and the box.



› Heat only until the solder flows, then quickly remove the torch. Quench in water. Remove the binding wire and steel pin, then pickle. After polishing and washing, slide a tight-fitting pin into place to test the fit. When everything works, polish the parts and slide a new hinge pin into place, riveting the ends slightly to prevent it from coming out.



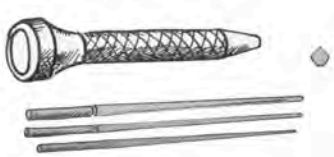
› It is frustrating to make a hinge and then discover the knuckles are weak because the tube seams were not soldered before starting. Be certain the tube is properly closed. Either use a commercial extruded tubing or double-check that the seam is well soldered before you cut the knuckles.



### *Cutting Broach*

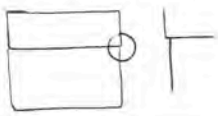
Even in well-made hinges the knuckles can be slightly out of alignment. This will result in a small amount of play or sloppiness in the hinge. Correct this with a gradually tapered, five-sided steel rod called a broach. These are sold in sets of a dozen in a progression of sizes.

With the hinge together, insert the broach, and gently roll it in your fingers to scrape away bits of metal inside the hinge. Pull it out and wipe it off often as work progresses. When contact is made with each knuckle, the lid will hold itself open. File a wire to a similar taper and tap it lightly into place.

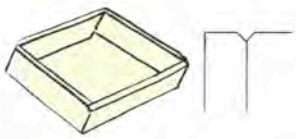


# Basic Hinge

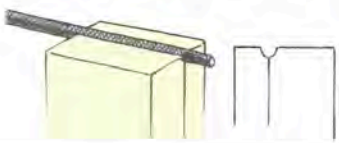
1. Prepare the object (in this example a rectangular box) by completing all soldering. Sand to a fine grit and pickle the work. Make sure the parts fit together well—it will be more difficult to adjust this after the hinge is in place. Some people find it helpful to glue the parts together for sanding.



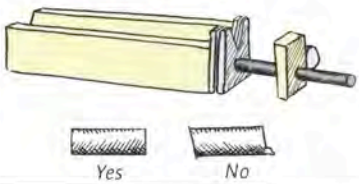
2. Separate the parts and file an angle along the two edges that will take the hinge. Each of these is a 45° angle, which creates a 90° angle when the top is set onto the box.



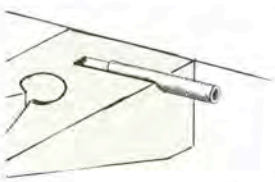
3. Secure the parts with glue or tape and convert the angled opening to a rounded one (e.g., change a "V" into a "U"). A tapered needle file can do the job, but a parallel round file is much better. An alternative is to find a steel rod (nail) with the same diameter as the hinge tube. Cut the end off square, mount this in a pin vise, and use it to scrape the groove.



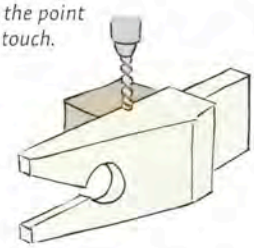
4. Clean the tube with Scotch-Brite to remove any finger oils and tarnish. Measure the length of the hinge and divide this into three or five parts. Set a tube cutting jig to this dimension and saw off the knuckles with a small sawblade. Inspect for burs, and remove them with careful filing.



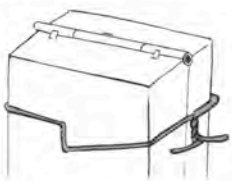

4A. If you don't have a jig, drill a hole in your benchpin that is precisely at a right angle. Mark the length on tape with a pen, and use this to both cut and file the ends square.



*Clamp a block of wood against the pin and drill at the point where they touch.*



5. Burn off any residual glue from Step #3 and tie the box and lid together with binding wire. Prop it so the hinge groove is conveniently angled, apply a small amount of flux, and set the knuckles in place. Lay a tiny bit of hard or medium solder against each knuckle and allow the flux to dry.



6. Gently heat the unit until the flux becomes crusty, then concentrate heat on one side. Bring this up to temperature, easing off as the solder starts to soften. Pull the heat away the instant the solder flows. Repeat on the other side. If you are not certain that the solder has flowed, resist the temptation to give it just another second. Resist!

7. Quench in water, remove the binding wire, and separate the parts. If they stick, gently wiggle them—sometimes there is a phantom join that easily comes apart. Clean up in pickle, and if part of the design, solder on a closure. Repickle, then finish the box with sanding, brassbrushing, patinas, etc. Insert a tight-fitting hinge pin and secure it as shown elsewhere.

# Cradle Hinge

## Cradle Hinge

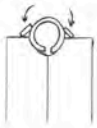
This style is especially good for round or oval boxes because the cradle provides increased contact between the parts. In addition, this hinge automatically creates a stop to prevent the lid from flopping too far open.

1. Prepare a trough by filing and scraping.

2. Buy or make two tubes that telescope together. Remember that soldered tubing can be drawn like wire, so it's pretty easy to get a good fit by drawing the tube through a drawplate.

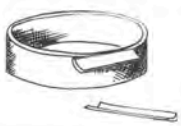
3. Cut a piece of the outer tube a bit longer than you think the hinge will be. Cut a slot along the axis of this tube.

4. Set this tube in position with the sawn slot located as shown, where the box and lid come together. Solder both sides.

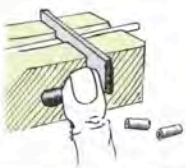


5. Cut the entire length on a line that is one-third away from the first slot. The lid will come away from the base.

6. Make another cut, this time removing one-third of the tube. The result is a pair of cradles that are parallel, well-attached to both parts, and that fit the knuckles perfectly.



7. Measure and cut hinge knuckles using a jig if available. This example shows three knuckles but any number may be used. An odd number is customary.



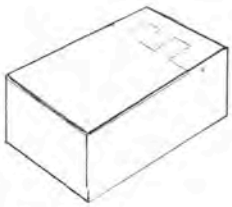
8. Set a knuckle into the cradle and solder it into place. Visually line this up with the center of the box.

9. Set the box and lid together and mark the location of the first knuckle with file notches on the opposite cradle.

*small notches*

10. Using the notches as guides, solder the other knuckles into their cradles. Check the placement. If it is incorrect, reheat and slide the knuckles as needed. Don't try to correct by grinding ... it never works. Pickle, polish, and set the hinge.

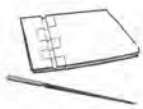
# Silversmith's Hinge



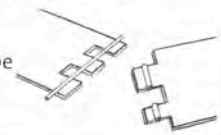
## Silversmith's Hinge with Tubing

1. Lay out and cut tabs. To be effective, the fit must be exact.

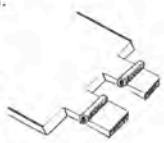
2. With the pieces held together, mark, and file a groove in both sections.



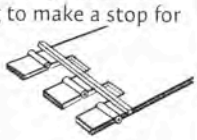
3. With the two pieces separated, solder a length of tubing into each groove. After soldering, cut away the extra bits of tube with a saw.

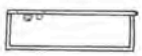


4. File a bevel on the underside of each cove in both pieces. Be careful not to file away the top edge, which would ruin the accuracy achieved in Step 1.

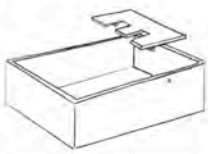


5. Solder square wire along one side in front of the tubing to make a stop for the lid. Higher and/or closer will limit the swing.



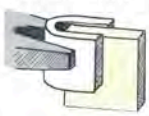


6. Solder the section with the stop to the piece. Drill a hole in the side of the object to allow the pin to enter.

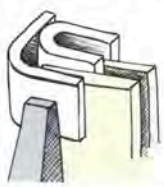


## Silversmith's Hinge with Sheet

1. Make knuckle units from heavy sheet (14–18 gauge). Cut a strip and bend it around another piece of the same gauge. Squeeze with parallel-jaw pliers or bend it in a vise.

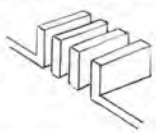


2. To make the third knuckle of this unit, temporarily solder a piece of strip in place and squeeze it in the same way.

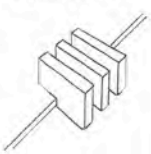


3. Use a similar trick to make the other half of the hinge, this one having four knuckles. Solder two units temporarily to a brace to hold them the correct distance apart (i.e., one thickness again).

4. Solder this unit onto the top of the container as shown. When soldering is complete, cut away the sheet between the knuckles.



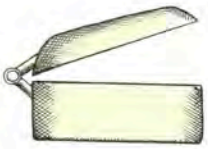
5. The first unit must overhang its edge to reach into the four-knuckle unit. To keep the top of the finished hinge flush, file a notch equal to the thickness of the sheet. Solder this unit to the lid. After trimming away excess, it will look like this.



6. Put the two units together and drill a hole through the whole assembly. Solder the top to the container, setting the pin either before or after soldering, depending on accessibility.

*In this example, the lid is attached (box is upside down) before the bottom is soldered into place.*

# Stand-Off Hinge

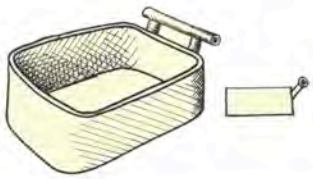


## Stand-Off Hinge

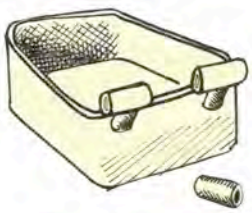
It's not that these hinges are especially rude that gives them their name, but rather that they lift up and away as they open. In the small scale of a jeweler, standoff hinges bring unexpected drama and novelty. This example is conservative, but the concept lends itself to unusual proportions and embellishments.

1. Make a box just like any other. Attach two arms to the base, projecting outward from the box.

2. Solder a length of tubing across the two arms.



3. Saw out a section of tubing from the center, generally dividing the tube into thirds.



4. Solder a wire onto the lid, eyeballing its relationship to the other arms. In most designs, you'll be able to adjust this later. Solder a piece of the same tubing (larger than the gap) onto the end of this wire.

*We can't all and some of us don't.*

*That's all there is to it.*

—

Eeyore (A. A. Milne)

5. After pickling and rinsing, position the tubes of both parts in alignment and slide a rod through the hinge. You might need to trim one or several of the knuckles to make things fit together.

6. Bend the arms with pliers to make the parts work together. When the fit is right, some designs will benefit from the addition of strengthening supports.

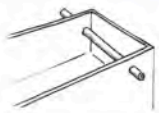
# Interior Hinges

## Interior, or Hidden Hinges

These hinges are related to the stand-off hinges described on the preceding page, but in this case the mechanism is behind the door or inside the box. You've seen them before—they're common on auto hoods, gas cap doors, and kitchen cabinets. This description uses a box as an example, but the hinge can be used in jewelry, hollowware, and other applications.

1. Make a box using any technique. Sketch a side view of the box to visualize how the hinge will work. Draw on tracing paper and pivot the lid open to see how it works.

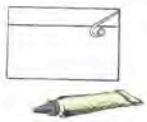
2. Drill a hole through the sides of the box and slide a length of tubing all the way through. File as needed to provide a snug fit.



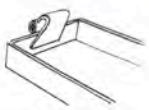
3. Cut two pieces of the tube, each a little longer than a third of the total hinge. Slide them onto a wire for alignment, and solder them into place. If the box walls are thin, provide additional bracing for these knuckles.

4. Cut a piece of the same tubing larger than the gap between the two parts inside the box and solder it to a piece of sheet. Your sketch will provide some guidance, but this can be a guess at this point.

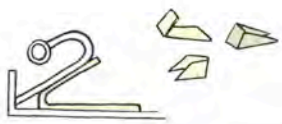
5. Temporarily assemble the parts and move the hinge to test its operation. Carefully observe how the swing works and bend the arm as needed to create clearance. Use epoxy or super glue to temporarily attach the lid onto the arm.



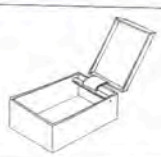
6. Mark the location of the arm on the inside of the lid, and cut a template of metal or stiff cardboard to capture the angle of the arm. Separate the parts and clean off all traces of glue.



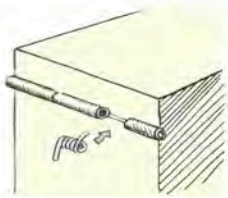
7. Flow a little solder onto the end of the arm, then prop it in position, using the template to check the angle. When it is accurate, solder the arm in place, again adding a brace if needed. Pickle, rinse and dry.



8. Test the action and make whatever adjustments are required to have the lid fall neatly into position. When all the parts work, permanently set the hinge with a tight-fitting pin. File, sand and burnish it flush on the outside of the box.



# Spring Hinges

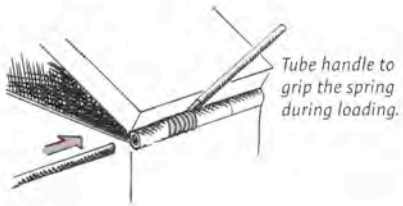


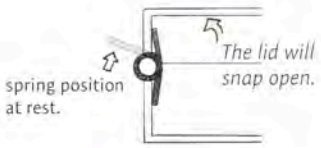
## Coil Spring

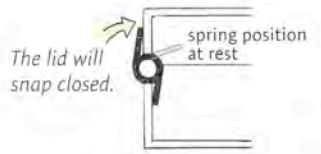
The spring is provided by a coil of hard-drawn wire. Depending on the weight of the lid and the fineness of the piece, this can be gold, sterling, brass, nickel silver, or steel. The steel may be salvaged from a pen spring.

Make the hinge in the usual way but leave a space that will be occupied by the spring. This can be accomplished by cutting away one of the knuckles but it will be neater if you plan ahead and leave a space when measuring the knuckles.

To assemble the hinge, load the spring into position before inserting the hinge pin. This can be a tricky operation and is easier with two people. The tails of the coil must protrude to make this spring work. Depending on where you put these you can make the lid spring open or snap closed. To camouflage the spring, make the knuckles from coiled wire.



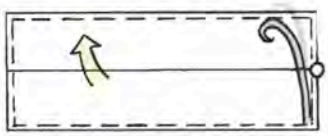

*Everything has beauty,*

*but not everyone sees it.*

Confucius

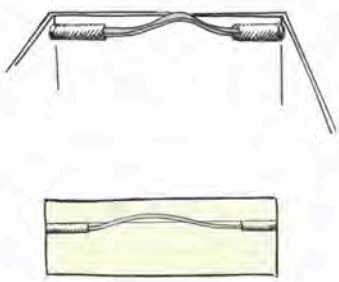
### *A Compression Spring*

This is best used where only a small push is needed. It is common on the covers of pocket watches, for instance. This spring is not in the hinge at all. Somewhere near the hinge is a piece of metal that is pushed down when the lid is closed. When the clasp is released the little tab pushes upward.



### *Leaf Springs*

A leaf spring is nothing more than a flat bar of springy material—think of a diving board. These can be used in multiples (look under a truck), but for jewelers they are usually nothing more than a toughened piece of metal bent so that it presses against a moving part.

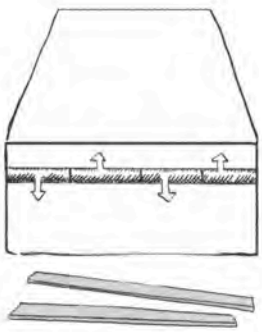


# Hinge Pin Spring

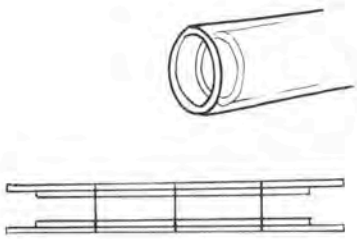
## Spring Pin

This mechanism is as clever as it is rewarding to make. The idea is that a normal hinge pin is replaced by a spring, which is loaded so that it is always under tension, either keeping a box closed or allowing it to spring open when a catch is released. The mechanism is virtually invisible, which adds to the appeal. The mechanism does not lend itself to short or slender hinges.

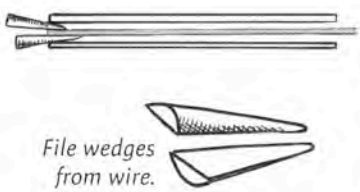
1. Make a hinge that is conventional in every way except that it has an even number of knuckles. This means that one end knuckle will be on the base and the other on the lid.



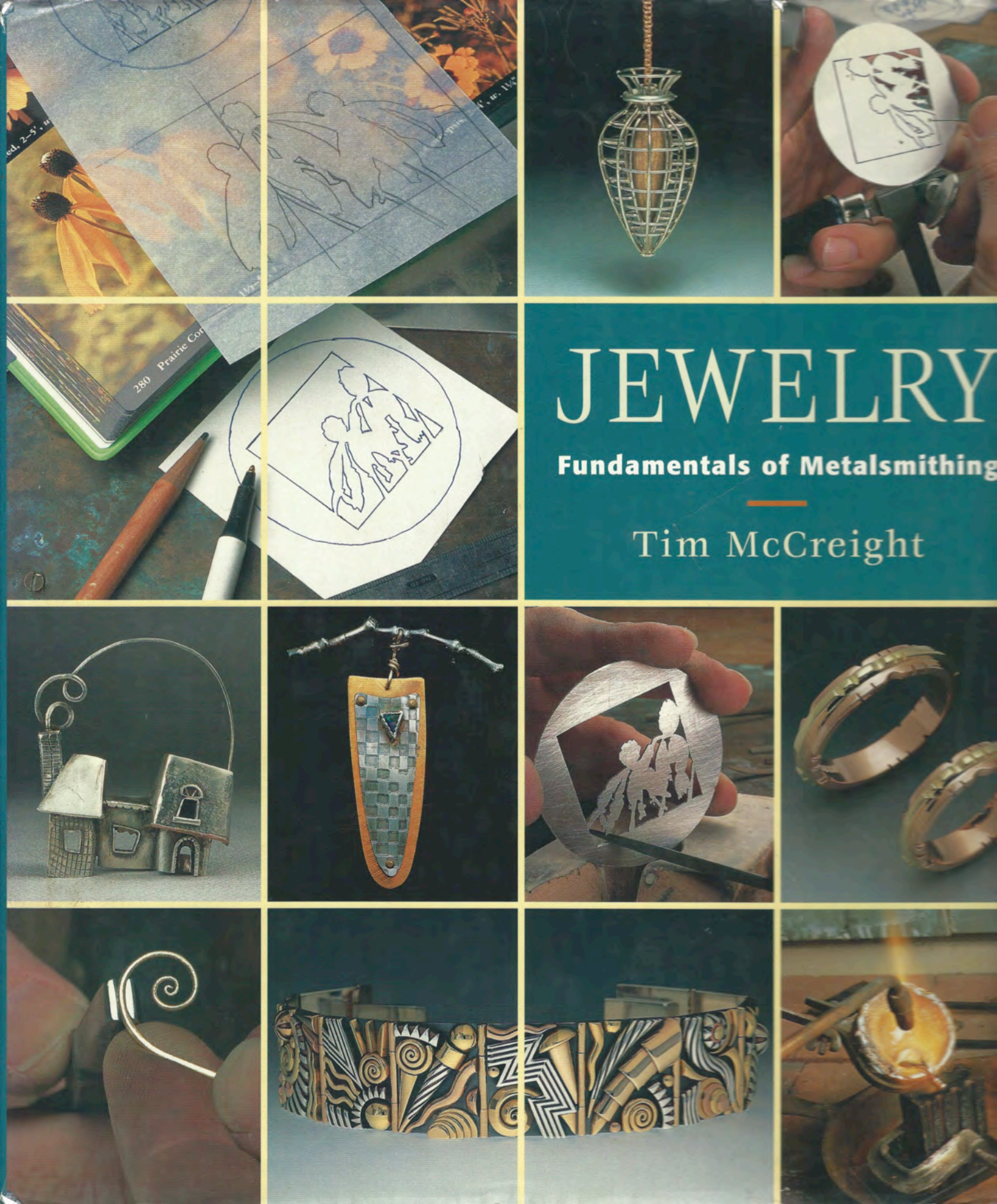
2. After polishing, slide a tight-fitting tube through the hinge to serve as the hinge pin, leaving it short by at least 3 mm on each end. This will provide strength and smooth operation. Skip this step if the hinge is small.



3. You will need several strips of flat springy metal. Watch mainsprings are best, but in a pinch, hard-drawn brass, or nickel silver can be flattened out and used. Cut two or three pieces about an inch longer than the hinge. Slide these through and lock them with a pair of wedges, tapped into place.



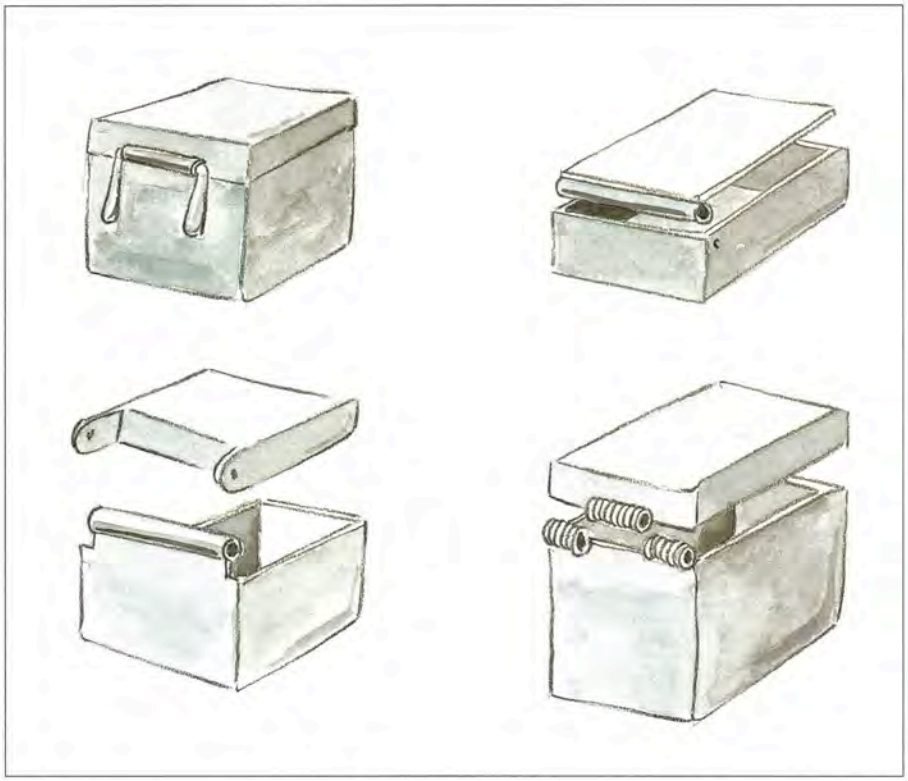

4. With pliers, grip the extending spring pieces and give them a twist. Lock in place with similar wedges and check the action. If slack, give another twist. Depending on the direction of the twist, the spring will pull the lid open or closed. When correct, tap another wedge firmly into place, and trim off the excess.



# JEWELRY

## Fundamentals of Metalsmithing

Tim McCreight



Hinge variations. The idea of a hinge is simple and open to many creative alternatives.

Grip a wooden dowel or hammer handle in a vise and, wrapping the chain around it loosely, stroke it back and forth to flex the weave. After a few minutes of this, anneal one more time and you're done.

### Woven Chain Variations

The chain just described uses the minimum number of loops, but any additional number can be used. To make a four-loop chain, simply make four "peaks" in step one. Or make five, or six or more. The more loops you have, the larger the hollow core in the center, and of course the larger the chain itself. The chain can be made of almost any size wire, though I rarely go larger than 22 gauge and usually prefer something around 26. Alternate metals can be spliced in to create a banded chain.

To make a tapered woven structure, add loops as the chain grows. For instance, after starting with a 3-loop chain, add a loop by simply creating one with the wire. Weave this 4-loop chain for several stitches, then add another, and so on. To reduce the taper, skip a loop periodically, folding it into the center of the chain. Of course, you won't be able to pull a tapered chain through a drawplate, so take care to keep the weaving symmetrical as you go.

## Hinges

Hinges have scores of uses in jewelry, from lockets to bracelets to poison rings. They allow an otherwise oversized piece to flex with the body, and can add excitement and mystery to a design. The possibilities are vast.

### Hinge Guidelines

- Prepare a precise seat for the tubing; time spent here will always be rewarded.
- Be certain every surface is clean before soldering.
- Trim all edges to remove burs, even the tiniest ones.
- Do not overheat a joint—remove the torch as soon as the solder starts to flow.
- Confidence is a valuable ally.

### Making Tubes

Hinges consist of *knuckles*—sections of tubing that are joined alternately to the two halves being hinged—and hinge pins. Knuckles

A woven taper. Additional loops are added as the chain grows to create an expanding form. This example was made by Mark Leahy.

Sara Shepherd, *This Book's Cover* brooch. Sterling, 14K. 1½ x 1¼".
*Photo by Douglas Yaple.*

**Tube Blank Sizes**

| inside diameter | gauge of sheet (B&S) 24 | 26 | 28 |
|---|---|---|---|
| 3mm | 11mm | 10.7mm | 10.5mm |
| 4mm | 14 | 13.8 | 13.6 |
| 5mm | 17.3 | 17 | 16.7 |
| 6mm | 20.5 | 20 | 19.9 |

are usually all the same size and traditionally appear in odd numbers, usually three or five. They are typically made of tubing, but you can also make a coil of wire (as for jump rings), flood it with solder, and cut off sections to be used for a hinge.

Sterling and gold tubing can be purchased from any company that supplies precious metal, while copper and brass tubes are often sold in hobby and craft stores. The range of sizes might be limited, but you can reduce tubing to a desired size with a drawplate. There are also times when it's handy to know how to make your own tubing, for instance when using an unusual metal or a size that is not commercially available.

### Tube Making Process

1. Roll or planish a strip of sheet metal until very thin, somewhere around 26 gauge or finer.
2. Cut and file a straight edge, then use dividers to drag out a parallel line. The width of this strip should be a little more than three times the intended inside diameter of the tube. For

## MAKING A TUBE





**1** The tubing blank is prepared with smooth, parallel edges.

**2** Begin the form by tapping the blank into a wooden groove.

**3** Draw the tube through the drawplate; keep the motion perpendicular to the plate.

**4** Solder the tube seam with hard solder.


j.e. Paterak, *Epiphany* locket. Sterling. 1¾" diameter.

a 3-millimeter tube, for instance, make a strip that is 10 or 11 millimeters wide. Cut neatly, and file the edges so they are true. Cut a point on one end to allow the strip to be inserted through a hole in the drawplate.

**3** Form the strip into a channel by striking a metal rod set on the strip as it lays in a wooden groove. Neither the groove nor the rod need be exactly the size of the final tube, as long as they are of a similar scale. Use pliers to ensure that the metal curls at least three-quarters of the way around the rod, paying special attention to the pointed end of the strip.

**4** Pull the tube through a drawplate, keeping it perpendicular to the plate. Move from larger to smaller holes until the seam closes. Anneal if necessary; it usually isn't.

As soon as the edges touch, stop drawing, and solder the seam, using solder chips placed at half-inch intervals.

**5** After soldering and pickling, the tube can be drawn down further if desired. This will not only reduce the diameter, but thicken the tube wall, as well.

## Making a Standard Hinge

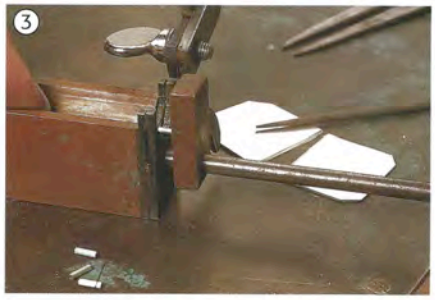
**1** Prepare the seat by first filing an estimated 45° angle on each surface. When laid beside each other, the two pieces will form a V-groove for the tubing. Hold the two pieces together and use a round file to convert this straight-sided groove into a curved *bearing* that matches the contour of the tubing.

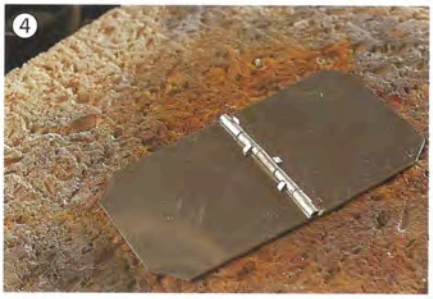
Anastacia Pesce, *Decision* locket. Sterling, fine silver, 18K, 22K, pearl, tourmaline. 3¼ x 1⅛".

## MAKING A STANDARD HINGE

1 File the edges of the pieces at an angle; when laid together they should form a "V."

2 Use a round needle file to give the groove a rounded contour matching the knuckles.



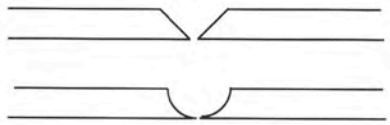


3-4 Use a tube-cutting jig to ensure straight edges and uniform size. Set a small piece of solder onto each knuckle.

5 The ends of the hinge pin are lightly riveted to secure it in place.

2 Clean finger oils off the tubing with Scotch-Brite while the tube is long and easy to hold on to, then cut off the intended number of knuckles.

Because tubing cut freehand tends to have an angled end, use a jig to help hold the saw blade vertical. Examine each knuckle after sawing and remove any burs that might cling to the ends.



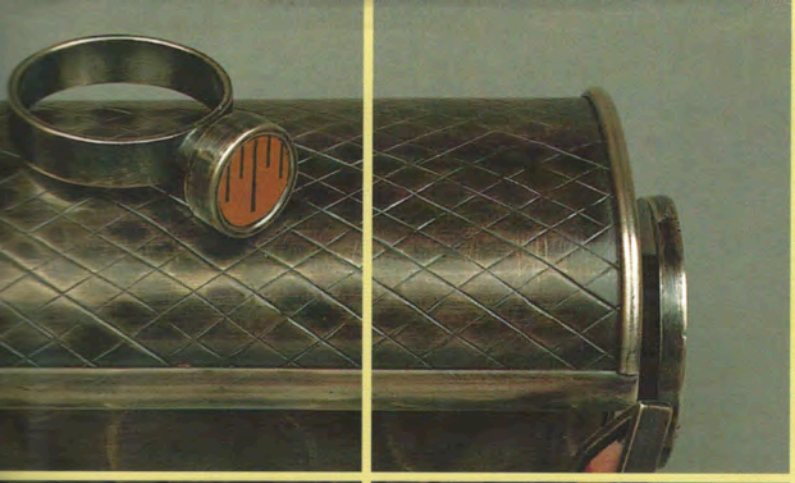
Hinge seat.

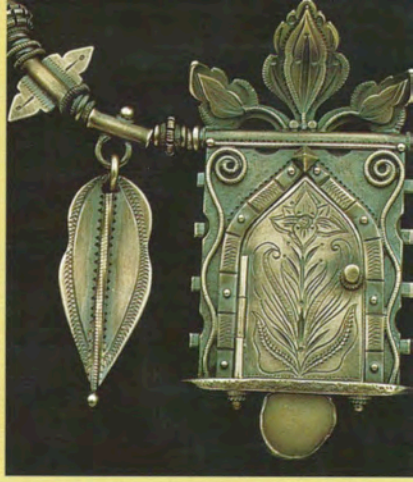
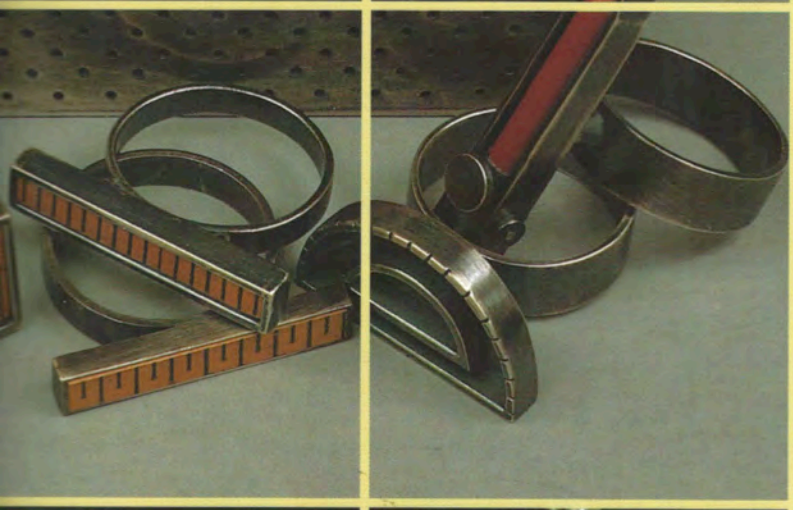
3 Flux both sides of the workpiece and set the tubes into place so they touch each other. Now you can see the importance of proper filing: if the groove is exactly the size of the tube, the knuckles will go just where you want them to.

4 Place a small piece of solder on each knuckle so it bridges the piece and the tubing. Heat one side until the solder flows, then heat the other side. In both cases, remove the torch as soon as the solder starts to move.

5 After pickling, slide a snug fitting wire into the tubes, checking each side independently to confirm alignment before attempting a complete assembly. If a lot of work is still needed, you might want to leave a piece of base metal wire in place to protect the tubes from being accidentally squashed.

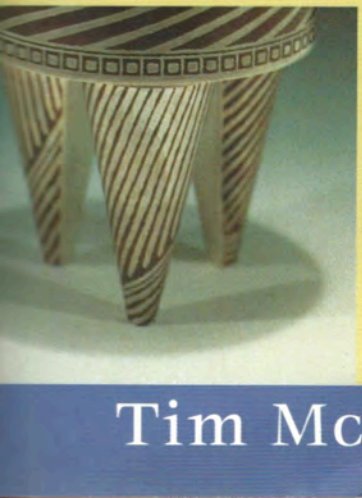
6 Make the final assembly only after all soldering is done, all stones are set, and any patina is complete. A light riveting action on the ends of the hinge pin will hold it in place.

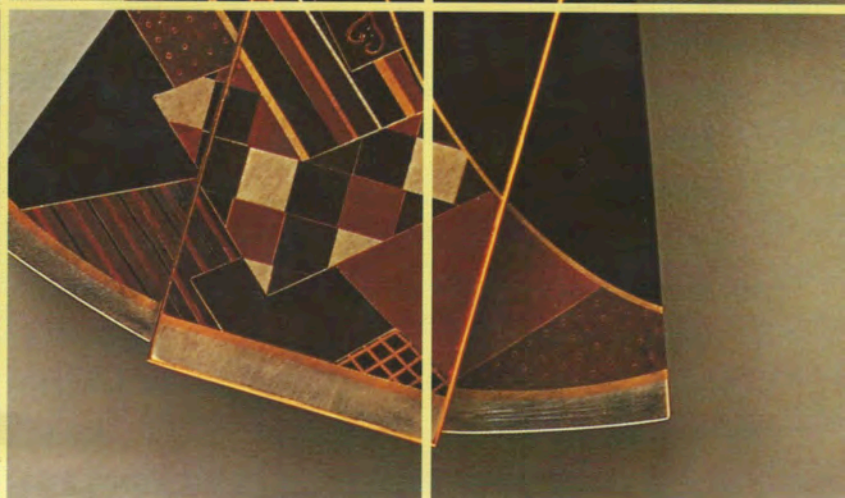


# The Metalsmith's Book of BOXES & LOCKETS





Tim McCreight

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Patty Bolz, container pendant. 22K, boulder opal, sapphire, diamonds, 2¼"H, photo: Robert Diamante.

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# 2

# Hinges & Lids

*This chapter describes a variety of hinges and lids, from simple to complex. Each design has its own reasons for being: each has a special look or feel, and many lend themselves to certain applications. Think of this chapter as a menu from which you can select the perfect hinge and lid for the box or locket you are making. As in the previous chapter on box construction, each example can be modified to yield a wide array of choices.*

One of the pleasures of working in small-scale metal construction is the fusion of art and engineering. Nowhere is this more true than in box making, and especially in the construction of hinges.

As varied as hinges are, a few observations apply to all hinges used in small-scale metalwork. This is the "Because that's how it is..." list, the annoying rules that we'd like to ignore but can't. You might want to come back and reread it every once in a while.

## Hinge Rules

1. A hinge must be straight.
2. Build it right rather than fix it later.
3. Close enough doesn't count.
4. Sequence is important.


Susan Bickford, *We Dreamt.* Sterling, copper, brass, 4"H x 1 1/2"W x 3/4"D.

1 **A hinge must be straight.** More specifically, the hinge pin, as well as the interior chamber of the hinge, must be straight as opposed to curved. The outside of a hinge can be sculpted to integrate with the curved contours of a form; this is familiar from compacts and watchcases. But the pin itself must be straight. If it isn't, the hinge will be tight and the pin will eventually break.

2 **Build it right rather than fix it later.** Though this advice makes sense in all fabrication, it has a specific meaning in the case of hinges.

Mariko Kusumoto, *Living Room* (interior). Sterling, nickel silver, wax, copper, found objects, 10½"H x 7½"W x 1"D, photos: M. Lee Fatherree.

Every box maker, at one time or another, has made a hinge that was *almost* perfect—perfect, except for that lump of solder where it shouldn't be or the tiny gap between components. In other aspects of fabrication, it's not uncommon to correct a small problem like this with a file or a bur. With hinges, that just won't work. The scale is so small and the tolerances so precise that even small problems can rarely be fixed in this way. More often, you'll waste time trying a half-dozen tools, mangle the hinge and get frustrated.

Get used to the idea of making it right, period. If the knuckles are too widely spaced, heat up the joint and push them closer together. If there is a lump of solder, heat up the area, dismantle the joint so you can clean it up, then put it back together.

Jiro J. Masuda, *Can You See Your Future With Her?* Sterling, 14K, mokumé, found object, 2" cube.

**3 Close enough doesn't count.** Tolerances in a hinged construction are very tight because the arc of the swing magnifies any problem. Picture it this way: if you loosen the hinge on your front door and slide a folded paper under the hinge, it will affect the swing so much that the door will bump against the jamb on the side opposite the hinge. The thickness of a folded sheet of paper will throw the fit off by as much as a quarter inch!

In small metal boxes, a poor fit will show up in several ways. If a hinge is not perpendicular to the axis of the box, the lid will tilt to one side as the box or locket is opened. If the hinge is not properly seated against the bearers, there will be a gap between the box and lid. If there is space between the knuckles of a hinge—even a fraction of a millimeter—the hinge will feel loose and sloppy.

These close tolerances can seem like a huge frustration or a worthy challenge. They force you to pay attention, but reward your effort with the satisfaction of a demanding task done well.

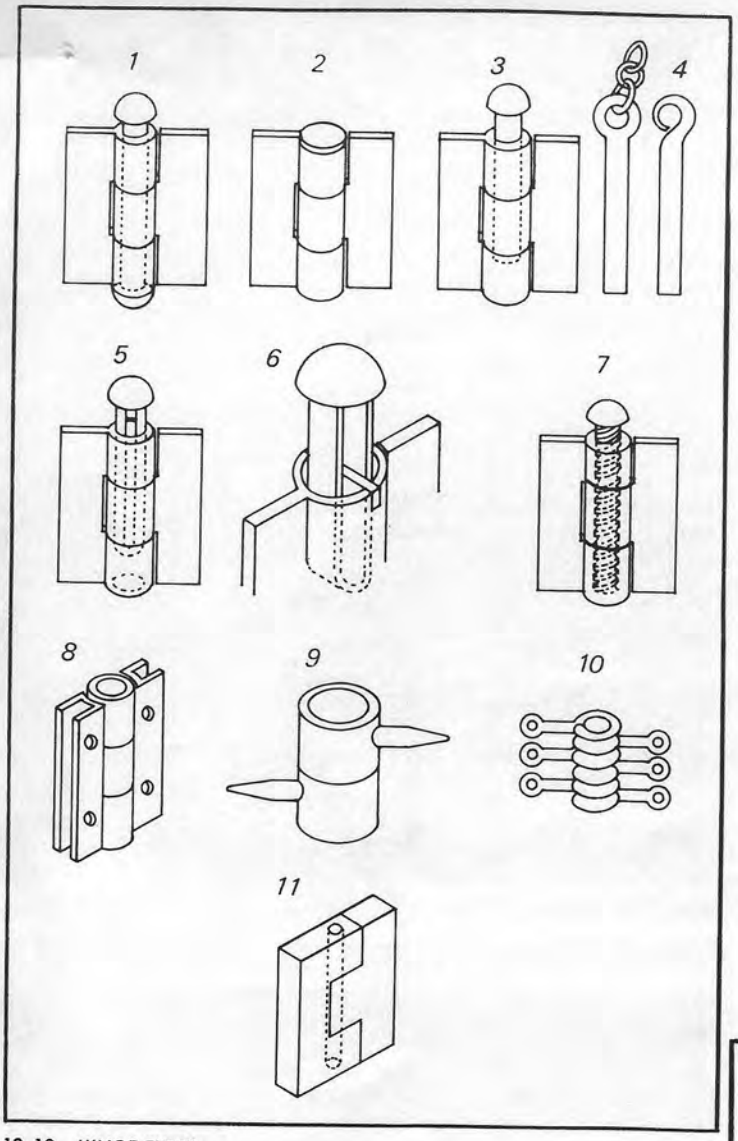
**4 Sequence is important.** Again, this is generally true in metal fabrication, but particularly important with hinges. How many of us have assembled a box with easy solder, forgetting, in the focus of getting this job done, that we still have a hinge and clasp to construct?

# JEWELRY

## CONCEPTS AND TECHNOLOGY

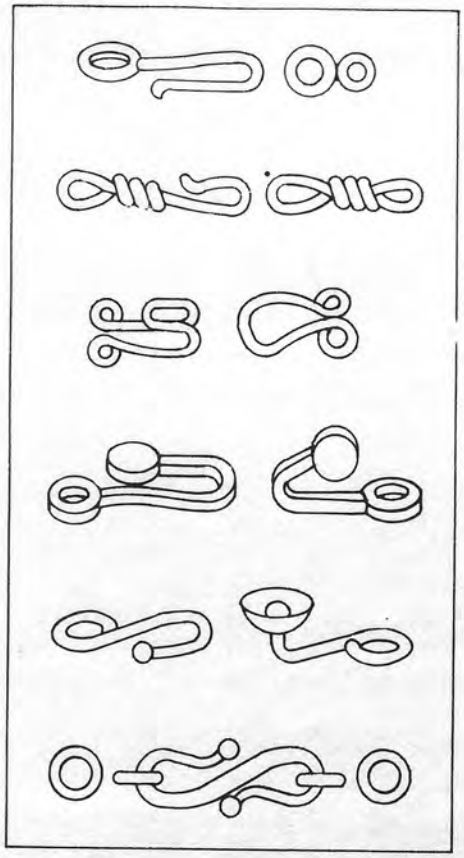
OPPI UNTRACHT

AUTHOR OF "METAL TECHNIQUES FOR CRAFTSMEN"

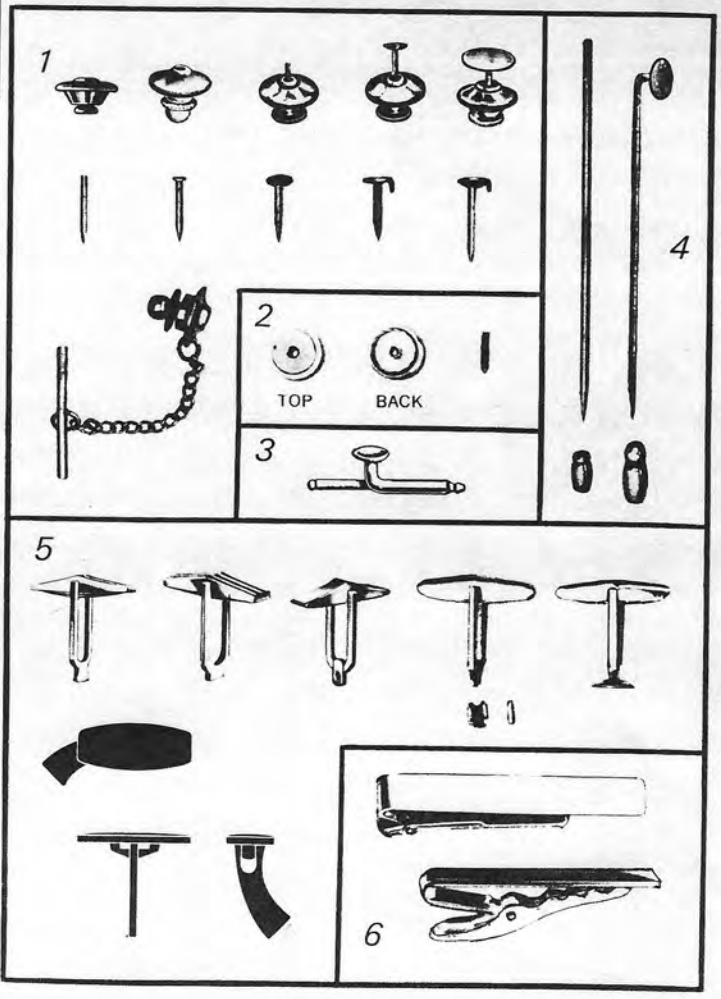



19–10 *HINGE TYPES*

1. A *typical hinge* which consists of *flaps* (leaves or bearers); cheniers or *knuckles;* and a *pin.* This is a three-knuckle hinge, the top and bottom knuckles attached to the left flap, and the center one to the right flap. The pin head has been shown raised above the top knuckle only to illustrate its position. In fact, both top and bottom heads would be formed like rivet heads, close upon the knuckles, but with just enough space so as not to freeze the hinge action. If this occurs, inject some tripoli and work the flap back and forth slowly till it moves freely.
2. A *permanent pin hinge* with flattened heads.
3. A *removable pin hinge,* which allows disengagement of the lugs.
4. *Removable pin* with soldered-on ring eye and attached guard chain to prevent loss; a pin with a forged eye, one piece.
5. A *removable split pin hinge.*
6. A *permanent split pin hinge* with soldered-in retaining crossbar.
7. *Removable screw pin* in internally threaded knuckles.
8. *Soft material hinge* with U-flaps having holes to allow for rivets or screws.
9. *Hook and eye hinge* with tapered pins to allow them to be cemented in place in soft materials.
10. *Wire ring hinge,* each unit riveted or screwed in place.
11. *Dovetail hinge* with internal, invisible riveted pin.



19–11 *HAND-FABRICATED HOOKS MADE OF WIRE, USED FOR CLOSINGS.*




19–12 *FASTENINGS*

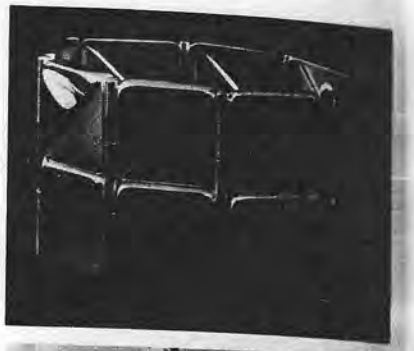
1. *Tie tack clutch button backs* and *stud posts* of various types; assembled with safety guard chain and buttonhole bar.
2. *Screw-type button back* with *screw post.*
3. *Pipe stem stud back* with internal spring allowing retraction of the short stem.
4. *Scarf, hat,* or *tie pinstem;* straight, and with attached disc; *scarf pinstem safety clutches.*
5. *Cuff link back types:* hard solder, plain top; hard solder, ribbed top; hard solder, swivel back, also shown disassembled with separate joint and rivet; soft solder type with attached patch; fold-back hinged type. (*V. M. Christensen A/S*)
6. *Tie clasps:* spring type; alligator-jaw clip type.

meet. Position the ring upright, ordinarily with the seam *down* so gravity helps the solder flow, by propping it up against a charcoal block. Place a single narrow solder snippet as long as the joint, on top of the joint on the inside of the band, and in contact with both joint sides. First heat the band or ring with a circular motion of the flame tip to bring up the temperature of the metal. When solder flow temperature is near, briefly place the flame tip on the seam which will cause the solder to flow. Be sure it flows the joint length, then quickly remove the flame. Do not unnecessarily prolong the heating process. Snip off the binding wire and immerse the band in pickle to clean it, remove, and rinse.

## THE HINGE

A *hinge* is an articulated construction used as a joining device. For purposes of discussion, we speak here of a hinge as a separate entity though in fact in jewelry it is also often an integral part of the piece. The diagram shows a typical hinge as a separate unit. It consists of two side *flaps* or *leaves* in their simplest form, as flat rectangles, but they may be curved or in any ornamental shape. Attached to the flaps are cylindrical forms variously called *lugs, cheniers,* or *knuckles,* that match in both external and internal diameter, and are lined up with each other. The lugs are called knuckles because they act in the same way as those finger joints of the hand. In jewelry, lugs are usually made of short sections of tubing, with exactly squared ends, but they can also be made of a tube shape made of a spiral of wire, or they can be an integral lug made of a cylindrically bent extension of the metal used for the flap. A hinge has a minimum of two, but usually is more stable with three or more lugs attached alternately to the two flaps. In the diagram, two are attached to the left flap and one to the right. They must be lined up with each other to allow the passage of a *retaining pin* that holds the hinge parts together. The flaps rotate around the pin. The amount of movement may be minimal to an angle of 180° (depending on where the restraining flange or stop device is placed), or up to a full 360°, called a *turnover hinge* (in which the flaps come completely flat on each side). The hinge can be completely invisible and used to articulate a part of the design concept. If flaps are used, they can be soldered to the back of the piece so that only the lugs show, or they can be visible and highly decorated.

PERMANENT PIN HINGES Hinges can be used to permanently hold parts together, in which case the pin is fixed in place like a flush-headed rivet by hammering down and upsetting its two ends. Such hinges are used to join units in a bracelet, pendant, or a necklace, and they can be almost invisible. The pin head can have any other shape such as round, as in the illustration.



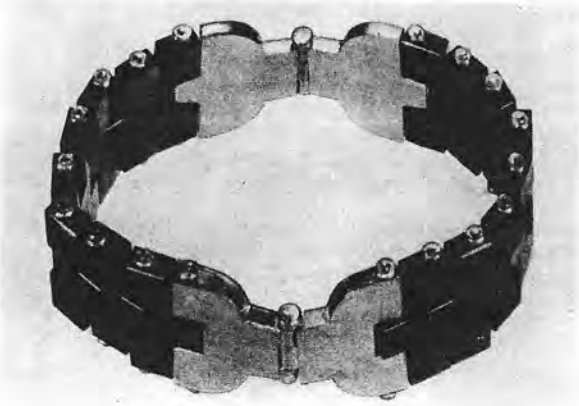
19–20 KAIJA AARIKKA, Finland, designer; manufacturer Aarikka Koru, Helsinki. Silver bracelet with three-lug hinges holding stamped parts that are half polished, half matte. The opening is a headed removable pin. *Photo: Seppo Vikman, courtesy Aarikka Koru*

19–21 JEREMY ROSS, England. Silver bracelet made of curved sheet parts joined by seven-lug hinges which are exposed and form decorative edges. *Photo: Ross*

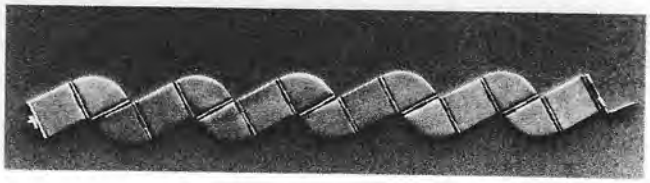
19–16 HELY JUVONEN, Finland, designer; manufacturer Kultakeskus Oy, Hämeenlinna. Gold cuff links with hinged findings that fold back and flatten completely for ease in insertion. *Photo: Kalevi Pekkonen, courtesy Kultakeskus Oy*

19–17 PAULA HÄIVÄOJA, Finland, designer; manufacturer Kalevala Koru, Helsinki. Silver cuff link in the form of a dovetail hinge with hidden rivet. *Photo: Studio Wendt, courtesy Kalevala Koru*

19–22 CHRISTA LÜHTJE, West Germany. Bracelet in green jade and gold. The stone parts were cut for the maker from drawings supplied to the lapidary. To hold them together, a gold tube was inserted in the vertically drilled holes that pass through each section, which makes the stone parts act as dovetail hinges. The gold closing is also a hinge with decorative side flaps and a removable pin. *Photo: Claus Hansmann*



19–18 TAISTO PALONEN, Finland, designer: manufacturer Kultateollisuus Oy, Turku. The hinges are used at right angles which gives great flexibility to the bracelet. *Photo: Oppi*



19–19 KARL GUSTAV HANSEN, Denmark, designer; manufacturer Hans Hansen Sølvsmedie, Kolding. Silver bracelet No. 2276. The concept of the entire design is a hinge with flaps in series. A headed removable screw-pin is used for opening and closing. *Photo: Courtesy Hans Hansen Sølvsmedie*

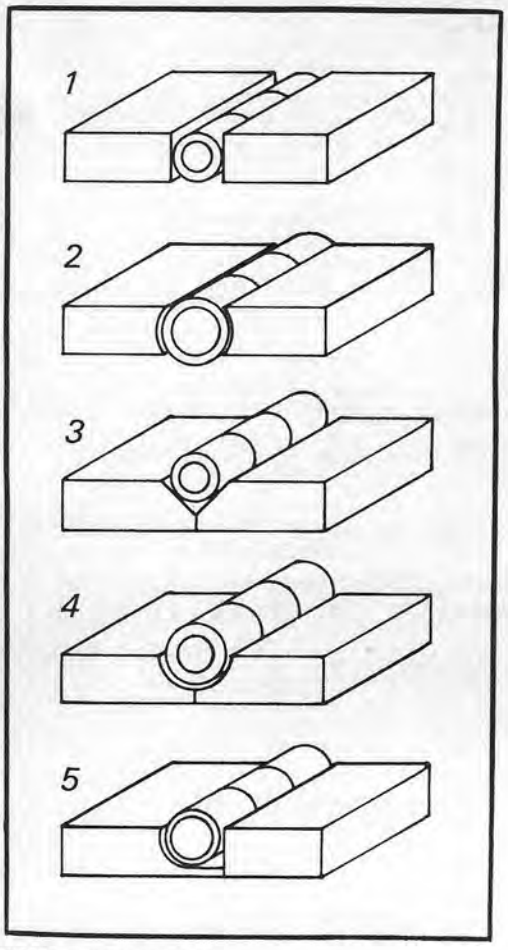
REMOVABLE PIN HINGES Hinges can also be used in a bracelet or belt to make a closing that can be opened. In this case, the pin is removable, and its head is usually large enough to allow it to be grasped. It may have an attached loop to simplify its removal, or allow the attachment of a *guard chain* to prevent its loss when removed.

THE SPLIT-PIN HINGE The pin in this case is made of a U-shaped half-round wire or flat wire with a space between. Into this space goes a crossbar that is soldered to the top of the top lug. A pin head is then soldered to the ends of the pin. This arrangement (see diagram) allows the pin to be removed as far as the top lug so the hinge can be opened. Because the pin cannot go further than the crossbar, it is attached to the piece and cannot be lost. Such a pin is commonly used on jewelry in the East.

THE REMOVABLE SCREW-PIN HINGE This headed pin has an external threaded screw that fits the internal thread of the lugs. It is safer than a plain, straight pin. It is also commonly used in jewelry in the East. The screw thread is often made from a wire coil. (See Making a Pseudoscrew, p. 427.) The screw-pin is completely removable.

HOOK AND EYE SOFT-MATERIAL HINGE A two-knuckle hinge with a tapered rod or spur soldered to each knuckle instead of a flap is used for hinging soft materials. The spur enters a hole drilled in soft materials such as wood or plastic, and is cemented there.

THE U-FLAP HINGE Another hinge type used on soft materials has U-shaped flaps that surround the soft material. They are pierced with holes that also penetrate the soft material, and pins are inserted and riveted into the hole to hold the ensemble together.




19–23 *THREE-KNUCKLE HINGES*
1. Flush hinge, squared-gap flaps, 360° hinge.
2. Flush hinge, curved profile gap flaps, 360° hinge.
3. Hidden hinge, angle-chamfer gap, 180° hinge.
4. Hidden hinge, book joint type, with curved profile gap, 180°.
5. Hidden hinge, with [illegible]

## CONSTRUCTING A HINGE

Measure the total length for the lugs or knuckles. Divide this measurement into a minimum of three equal parts, the most common number used. Two-lug hinges are sometimes used when each of them is long enough, but they are not as strong or as stable as a three-lug hinge. Hinges with more than three lugs are common. An odd number of lugs keeps the pin in line as both ends are held by the same side or flap, and this prevents the pin from bending.

When cutting tubing, to assure squared ends, avoid waste, and unnecessary work, some device to hold the tube perpendicular to the cut is needed as this can rarely be done freehand with accuracy. A simple device is a *hardwood block* with squared ends and a V-shaped lengthwise groove perpendicular to its ends. This can be easily made, and is useful in guiding the saw to make accurate, true cuts and it also serves as a template when finishing a cut end. *Joint tools* are also used to hold tubing and wire while it is cut. (See Tubing, Chapter 7, Illustration 7–29.)

Mark and cut the lugs one at a time from seamed or seamless tubing, on each of them allowing a fraction more than is needed for trimming and truing. They are marked and cut *separately* because there is some loss of metal in the cutting groove and inaccuracies can occur. Place the tube in the V-groove of the wood block and while holding it down firmly with the fingers, cut through the tube, holding the saw blade close to the block end. When sawing tubing, make an initial groove, start slowly, and use little pressure before arriving at midway, then increase the pressure.

To assure a close-fitting hinge, the lug ends must be finished at a 90° angle to the tube axis. After the tube is sawed through, finish and square the end by placing it flush with the block end, and while holding it firmly, file or stone the end true. The tube can also be placed between two pieces of hardwood with a groove to hold the tube in place, then clamped together. Measure the tube from this finished end, and again allowing a fraction for trimming and truing, cut off the lug and finish its ends in the same way. Do the same for the others needed.

To check the accuracy of fit and total length, thread all lugs on a straight iron or steel wire *driftpin* having the same gauge thickness as the metal pin used later. Aligning two or more holes in an object by inserting a pin is termed *drifting*. This same wire driftpin is used during soldering, as described below. Assembled, the lugs appear as they will be after soldering. Defects such as space between lugs due to inaccurate end squaring can be seen and corrected. Lugs that do not fit closely together allow an undesirable looseness and eccentric, lengthwise movement of the hinge.

## LUG PLACEMENT

There are various ways of placing the lugs depending on whether they are to be visible or not. If visible, they are butt ended with the flaps. If invisible, the flap or sheet metal edge must be either chamfered or cut off at the corners to an angle, or a rounded, concave depression must be made to accommodate the lugs as illustrated in the diagrams in this section.

## SOLDERING THE LUGS

The lugs are soldered in alternating order to the opposite flaps. Place them in position, assembled on the iron driftpin wire mentioned. Iron or steel wire is used in the soldering operation because it has a higher melting temperature than the precious and nonferrous metals, therefore there is less chance of the solder fusing to it. For future reference, mark the position of each lug location on the flap with a *scriber*.

The biggest problem in hinge making is to prevent the flow

of solder to unwanted places which can cause the hinge to freeze. Remove the iron driftpin, coat it with a solder inhibitor such as yellow ochre, and allow this to dry. Clean each lug and carefully coat each *end only* with yellow ochre and allow it to dry. Coat the flaps with flux and dry. The reason for drying in advance is to eliminate all mechanically combined liquid which can cause the yellow ochre to flow to unwanted places and thus make complications by preventing the flow of solder to where it *is* wanted.

Reassemble the lugs on the iron driftpin and place them according to the marked position in contact with the flaps which are now resting on a soldering surface. Leave the iron driftpin inside during soldering to assure the correct alignment of the lugs by holding them in place. If *seamed tubing* is used for lugs, place the seam in contact with the flap so it is soldered closed at the time of joining. To increase the contact area between the lug and the flap, before placing the lugs, while they are on the iron pin, run a *file* down their length to flatten one side. Put this flat side in contact with the flaps.

Dip a small minimal snippet of hard solder in flux, and dry it. Place one of these snippets in contact with *each* lug and flap, *on the side to which it is to be joined.* Avoid using too large a piece of solder which can flood the joint and freeze the hinge. With a small-size torch tip and a soft flame, slowly heat the metal to drive off any moisture in the assembly, and when all evidence of moisture disappears, add more air to point the flame. Concentrate the heat on the solder, and remove the flame as soon as the solder flows. Do not unnecessarily prolong the heat.

Allow the hinge to cool. While the pin is still in the lugs, test the movement of the hinge to see that it is operative and that the lugs have been joined. If a lug comes loose, reflux the joint and repeat the heating. If solder flows *inside* the lug, remove it with a *reamer* of appropriate size.

Before pickling, remove the iron driftpin with pliers, and scrub off the yellow ochre to avoid contaminating the pickle. Again check each lug to see if it is held securely. Small adjustments can be made with a file if needed. Should the hinge freeze with solder, it must be heated again to solder flow temperature, and the frozen parts removed. All solder is then filed away and the process repeated.

### RIVETING A PERMANENT HINGE PIN

The pin used (also called a *joint pin*) should be of the same diameter as the inside of the lug. Its thickness should be not less than the thickness of the lug wall. Preferably the pin should be of the same metal as used for the work. However, high-karat gold and sterling silver are weaker for this purpose than a lower karat gold or coin or 830/1000 silver, or nickel silver pin wire. If a question of preserving the appearance of the work comes up, a head of the same metal as the work can be soldered to the pin if it is a different metal. It is also possible to use *tubing* as a pin, which then becomes a form of open rivet.

Cut the pin somewhat longer than the total length needed, and anneal it. Hammer one end, holding the pin upright in the hinge while the other end is supported in the depression of a *dapping block* (for round-headed pins) or a *flat surface block* (for flat-headed pins). After a few blows to spread the pin end, reverse its position on the support and upset the other end in the same way. To flange out a tube rivet end, place the tube on a *round-ended dapping tool* fixed upright in a bench vise, then place another dapping tool on the opposite end and hammer straight down. This should flange both ends simultaneously. Avoid hammering the pin ends to the point where hinge movement is hindered. Test the hinge movement in stages during this process. In some circumstances, it may be convenient to first form a head on one end of the pin, or solder on a head at one end, then insert the pin and form the opposite end, as when making a rivet.

When the pin is fixed, it should not shake. If it seems loose, the pin gauge was probably too small for the inner lug diameter. There should be no play between pin and lug thickness.

### THE INTEGRAL LUG

A hinge can be made by making the lug an integral extension of the flap. In this case, the metal for the lug part must be bent into a round cylindrical shape to accommodate the pin. This is done by first bending the lug ends on one flap with *round-nosed pliers* to form the initial curve. Then insert a steel rod the size of the pin to act as a mandrel, and *hammer* the lug over it to form a cylinder. Remove the rod. Repeat the process for the lug ends on the opposite flap. Assemble the hinge on the same rod and make adjustments to be sure they are lined up.

## THE SPRING

The spring is a form of spiral. Spring forms exist everywhere in nature, so it is no surprise that at an early date, they were imitated and used by man. The spring is a means of storing energy. In the case of metal, this storage occurs when the metal of the spring has resilience that allows it to be stretched or compressed, and then, of its own will, to recover and return to its original shape by *elasticity*.

Springs are used in kinetic jewelry such as headdresses, combs, and brooches. When used to mount a part of an ornament, the part will move in air with the movement of the wearer. Brooches sometimes have faceted precious stones such as diamonds mounted on a spring *en tremblant*, so that with the slightest movement, they scintillate.

Springs are also used to put tension on a member in a way that is otherwise impossible, as when tensioning a wire.

**19–24 JEREMY ROSS, England. Silver ring with hinged shank, and resin-filled lid with silver inserts. The ring opens to reveal two compartments, each with its own hinged lid. *Photo: Michael Goldwater***