THE TREBLE VIOL

or: A Dissertation on the Construction of the
Treble Viol da Gamba

FOR PROFESSIONAL LUTHIERS, OR AMATEUR TINKERERS
LIKE MYSELF

Fred. E. LaBarre

North Lights Studio Press
Barre, Vermont

Dedicated to:

My wife Joanne, who lovingly puts up with my tinkering; and plays the results; and to Peter Tourin, whose help and encouragement has been immense.

International Standard Book Number 0-9604086-0-6
Library of Congress Catalog Card Number 80-81385

Published by: Frederick E. LaBarre, North Troy, Vermont 05859, U.S.A.
Printed in the United States of America.

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1. INTRODUCTION

When I started out on this work, my purpose was not so much to write a book, as it was to logically arrange the information that it took to build a viola da gamba. I first saw and heard the gamba some five years ago this writing, and it was love at first sight. At the time, I had become interested in violin building, for which there is a great deal of available information, but I found that there was an equal scarcity of information on the viol. The Boston Museum of Fine Arts, through the master luthier Donald Warnock[6] has helped to correct this situation by the publishing of plans and construction notes for the Division viol. These plans are written towards an experienced luthier, and as I am far from that, I needed more information.

This short book then is the result of several years of work and study, of successes and mistakes, of uncovering avenues and of coming up short on dead ends.

I've tried to make the book useful for all skill levels, and for all philosophies; as a consequence, it's probably bigger than it ought to be. If you are a beginner, or a purist who likes to start from the tree and do it all, it's all there. If you're a skilled luthier, you will recognize the "kid stuff" and skip over to the "good parts". I found it useful to do each part the hard way at least once, just to get a feel, and appreciation, for the skills of the old time master builders. (It also helps to reconcile you to the price of all ready and prepared wood from a supplier, once you find out how much work it saves.) I've also tried to make the book fun to read. How much fun, I guess, depends on your sense of humor. Humor in northeastern Vermont, where this was written, tends toward the, "I wouldn't start from here if I were going to - - -", variety.

The very least I can hope for, is, if this is like most books that I've read, that you can learn at least one new (or better) way of doing something by reading this.

Good luck on your first viol.

Fred. LaBarre

2. DESCRIPTION

GENERAL

The gamba family has the outward appearance of rather tubby members of the violin family. The majority of the viols are broader in proportion than the violin family, deeper through the body, have flat backs with a short taper to the neck at the upper end, are lacking the corners at the center bouts, without overhang at the edges, the center bouts are not recurved at their ends, the neck to body junction is concave, they are equipped with from five to seven strings, and have tied frets.

Most of the viols seen have sound holes which are C shaped. F holes are also found, especially on Italian viols, and a peculiar flame shaped hole, very similar to those usually found on the viol d'amore is characteristic of the German viols.

The tailpiece is usually held by a hook-bar, inlet vertically into the lower end block, and fitting up through a square hole in the tailpiece. Some of the Italian viols have a tailpiece/gut arrangement, identical to that of the violin family.

SIZES AND TUNING

There are nine recognized sizes in the gamba family today. Their sizes and tunings are listed in the following tables. As may be expected, due to the lack of standardization when the gamba was popular, some are found which defy exact classification.

As others have prepared excellent construction information and plans on other sizes of the viola da gamba, this book will concern itself with the treble viol only. One good reason for starting with the treble viol is that violin builders, wishing to try their skills at the construction of a member of this fine old family of instruments, will find that a great many of the tools, techniques, and material sizes are the same. Larger members of the gamba family, while somewhat more popular with players, pose problems in materials (especially for back and neck).

DESCRIPTION

Sizes and Tuning (Continued)

TABLE 2-1. Viol Sizes

NAME	BODY LENGTH	VIBRATING STRING LENGTH
Pardessus	12-3/8" to 12-5/8" (31.4 cm to 32 cm)	12-5/8" to 12-7/8" (32 cm to 32.7 cm)
Treble	13-3/4" to 15" (35 cm to 38.1 cm)	13-3/4" to 14" (35 cm to 35.6 cm)
Alto	15" to 16" (38 cm to 40.6 cm)	15" to 15-7/8" (38 cm to 40.3 cm)
Tenor	18-1/2" to 20-3/4" (47 cm to 52.7 cm)	17-1/2" to 21-1/2" (44.5 cm to 54.6 cm)
Lyra	21-3/4" to 23-3/4" (55.3 cm to 60.3 cm)	21" to 23-3/4" (53.3 cm to 60.3 cm)
Division	24-1/4" to 26-3/4" (61.6 cm to 68 cm)	25-1/2" to 26" (64.8 cm to 66 cm)
Bass	26-1/2" to 27-3/4" (67.3 cm to 70.5 cm)	26-1/2" to 27-1/2" (67.3 cm to 69.9 cm)
Violone	38-5/8" to 39-1/2" (98.1 cm to 100.3 cm)	38" to 39-1/2" (96.5 cm to 100.3 cm)

PLAYING

A full description of playing techniques is out of the scope of this book. May excellent books are available, either reprints of old books, or newly written ones. A partial list of those available, and their sources, may be found in the bibliography at the end of this book.

Briefly, the viola da gamba (viol of the leg) is held between the knees (smaller sizes) or the calves of the legs (larger sizes). The scroll rests back on the left chest or shoulder, where the left hand may easily finger the strings. The bow is held in the hand with the palm outward, with the fingers on the bow hair.

In a pinch, a treble gamba may be played with a full, or 4/4 size violin bow, but a true viol bow is a little longer and arched away from the strings when tensioned, and the bow hair is not under as much tension as a violin bow. The fingers resting on

	AA	BB	CC	DD	EE	FF	GG	A	B	C	D	E	F	G	a	b	c	d	e	f	g	a'	b'	c'	d'	e'	f'	g'	a"	b"	c"	d"	e"	f"	g"
Pardessus																					(6)			5		4			3			2			1
Treble																		6			5			4		3			2			1			
Alto																	6			5		4			3			2			(1)			
Tenor														(6)			5			4		3			2			1						
Lyra (32 variable tunings)																																	(2 major tunings)	
Division											6			5			4		3			2			1									
Bass								(7)			6			5			4		3			2			1									
Violone		6			5			4			3			2			1																	
"Continental" Bass																																			
7		6			5			4			3			2			1																	

TABLE 2-2. Viol Tunings

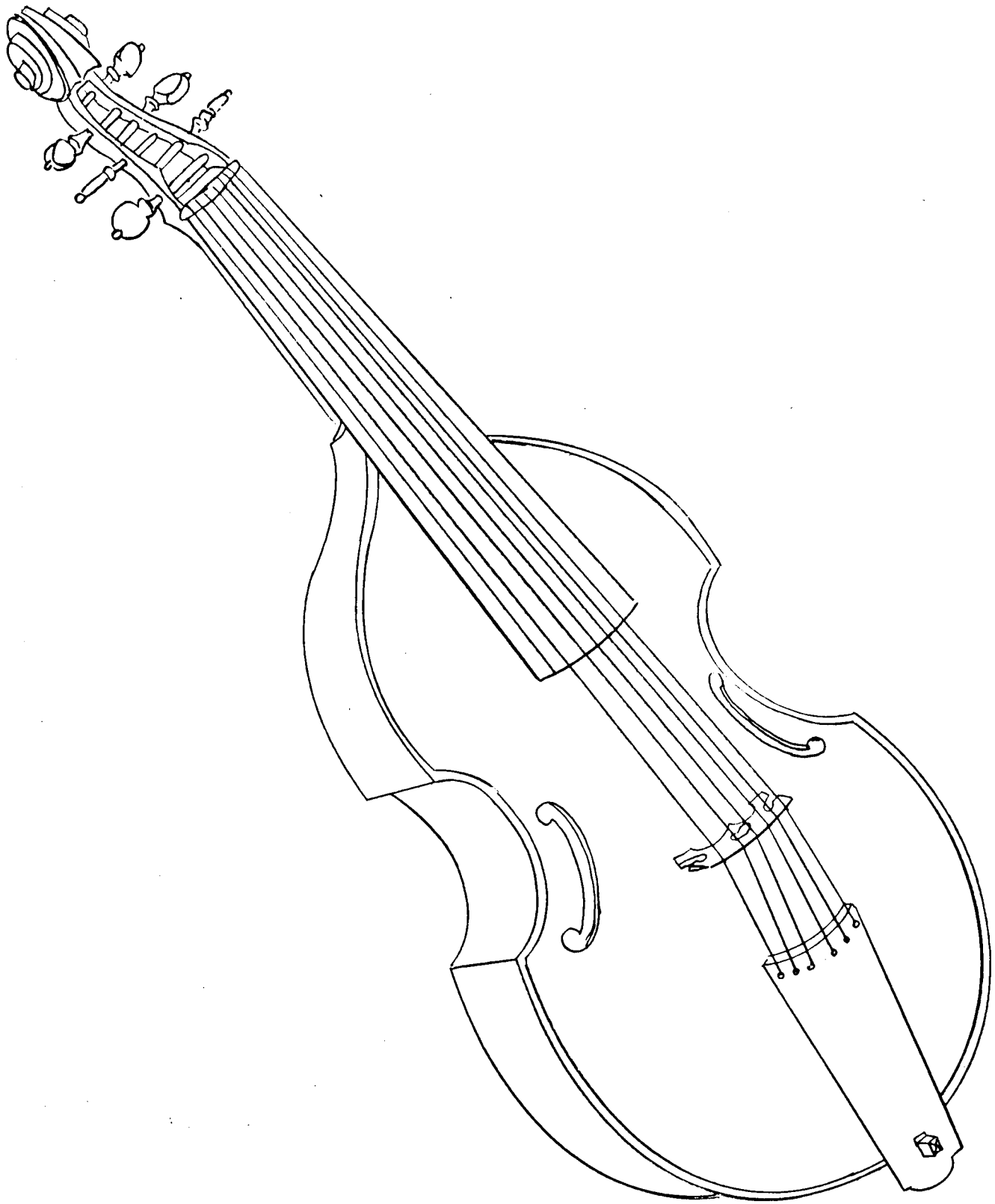


Figure 2-1. The Viola da Gamba

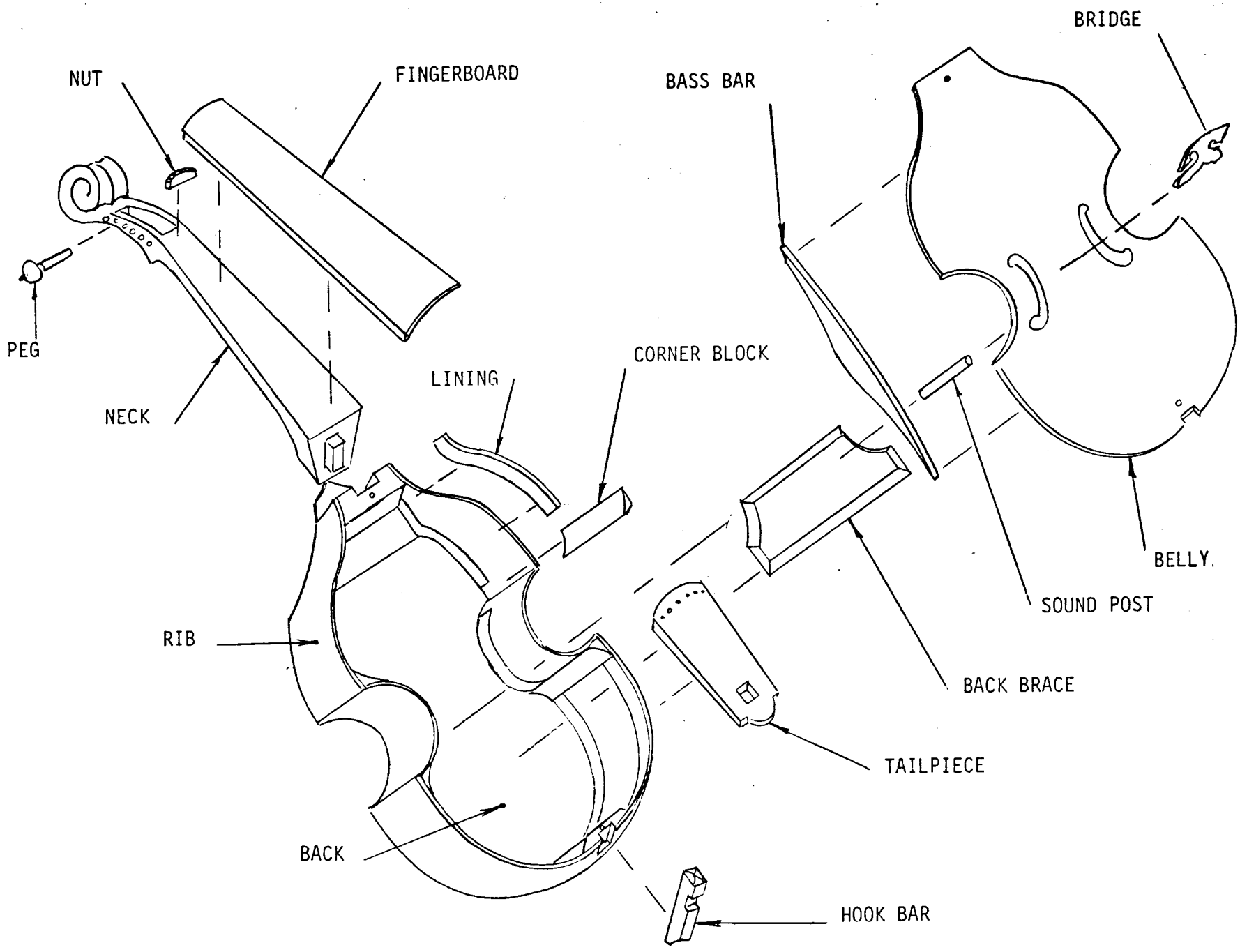


Figure 2-2. Parts of the Viol

Playing (Continued)
the bow hair allow the tension of the hair to be changed while playing. The "flavor" of the music with a viol bow is quite different than that played with the violin bow of today.

Generally speaking, any music that sounds good on a violin sounds good on a treble viol. The gamba hasn't the volume of a violin, but each note has a special clarity, due to the frets. The gamba is better suited for small group, intimate music than to large concert halls.

I have heard everything from bluegrass ballads to Bach done well on the gamba. However, it seems that if the date of the music being played is within the time of the gamba's popularity, it fits better. One excellent source of music is the Episcopal Hymnal. Many of the tunes are contemporary with the gamba, and some of those by J.S. Bach were undoubtedly written for it.

3. ORIGINAL CONSTRUCTION

GENERAL

At first glance, the gamba looks like a marriage of violin and guitar.

Belly

The belly is arched and graduated in thickness, but usually lacks a hollow around the edge, and has no overhang.

Back

The back is flat, slanting slightly upward to the neck at the upper end. In German instruments it is sometimes rather heavily braced, as in a guitar. Other instruments, particularly the French ones, are often very lightly built, with just the one back brace, and no back lining or corner blocks.

The back always has one broad back brace, centered at about the lower corners of the center bouts. This serves as support to the lower end of the sound post.

Ribs

The ribs are deeper (belly to back) than those of the violin family, and of thicker material. Where a violin rib runs about 3/64" in thickness a treble gamba rib is around 3/32". This is about the same as a violin rib with lining so that the back lining can safely be omitted, while still maintaining the same width of glue joint.

Linings

As I said before, the back linings are sometimes omitted, but the belly linings are almost always there, especially in larger instruments. Sometimes, if the back linings are omitted, small triangular blocks of maple are spaced around the juncture of rib and back; or linings of linen strips 3/4" on either side of the joint are used.

ORIGINAL CONSTRUCTION

Blocks

The neck block and tail block are always installed, but the corner blocks at the center bouts are sometimes omitted. Here again, linen linings may be found in place of corner blocks.

Locating Pegs

The belly will usually be found to have locating pegs of spruce let into the top and bottom blocks. These are similar to those found on early violins. They serve a very useful purpose in the viola da gamba when the top has to be removed for repairs, or for tuning. Since the gamba has no overhang at the edges, misalignment becomes very obvious.

Neck

The gamba neck is long, and generously broad, to carry its large compliment of strings. Roughly three types of scroll end are found; a conventional scroll or variation thereof, a carved head of human or animal, and a trumpet-shaped scroll with flat face. The peg box is wide and shallow, relieved at the nut end to clear the first and last strings. The handle portion of the neck is very shallow, both to keep down the weight, and to assist in fingering.

The neck to body joint is made in as many ways as violin necks have been. The necks can be found built-in, as on Spanish guitars; flush glued; tenoned; and dovetailed. The most common joint is a tenon, glued, and reinforced with nails driven through from inside the body cavity before the belly is glued on.

Fingerboard

The fingerboard is usually made of the same wood as is the neck, and veneered rather thickly on the top surface. Solid ebony is not usually used, especially in the larger instruments, because of its weight. The fingerboard is quite often greatly hollowed out underneath for most, or all, of its length. The fingerboard and tailpiece

Fingerboard (Continued)
are sometimes ornamented with an inlay of contrasting geometric designs, and the end closest to the bridge is sometimes scalloped, or given an ogee curve design.

Tailpiece

The tailpiece matches the fingerboard in materials, inlay, and decoration. It is retained in place by a square hole, fitting over the upper, notched end of the hook-bar. (Or in the case of the Italian instruments, a tailpiece gut and tail peg arrangement.) Holes are drilled through the upper end for the strings, but these are not keyhole shaped as in a violin. There is no tailpiece bridge under the strings at the upper end.

Bridge

The bridge is made of spotted maple. It is shaped like the early violin family bridges. (Or early violin bridges were shaped like gamba bridges, take your pick!) The top is approximately the same curve as the fingerboard at the bridge end, and offset to bring the treble strings down closer to the fingerboard than the bass strings.

Pegs

The pegs are longer than violin pegs, because of the wider pegbox. Pegheads are usually decorated in some way; from an inlaid button on the end to a fancy shape, to ivory or other coverings or inlays. Rosewood, ebony, boxwood, and maple pegs are common.

Purfling

Purfling ranges from belly only (if the back is especially well figured) to elaborate borders on the sides, and geometric patterns on the back at the top, bottom and bout corners. Single lines, double lines, and light-dark lines are to be found. The belly is usually purfled after the top is scraped for tuning.

ORIGINAL CONSTRUCTION

Accessories

The nut, and tailpiece saddle if needed, are made of ebony. The frets are made of gut, of about the thickness of a violin A or D string, or more recently of heavy nylon fish leader (.030"). The frets are doubled, and tied on the bass side with one of several different traditional fret knots. The frets can be moved very slightly for tuning purposes. Strings originally were gut, and wrapped gut.

Bass Bar

The bass bar is located under the foot of the bridge on the bass side, and runs at a slight angle top to bottom. (Closer to center at the top.)

Sound Post

The sound post is located slightly below the treble foot of the bridge, and in a line with it. It is vertical in both directions, with its foot against the back brace. Both the bass bar and sound post have the same great importance and effect on a gamba as they do on a violin.

MATERIALS

Early violas da gamba were made of the same traditional materials as were the members of the violin family.

The bellies were made of European white spruce or tamarack (eastern Larch), or even of close grained pine or fir. In larger instruments, an especially fine piece of wood would sometimes be pieced at the extreme edges of the lower bouts.

The backs and sides were made of European maple (called in German, Ahorn) or sycamore maple (Acer pseudo plantanus), sometimes called harewood or of other plain or figured hardwoods, such as pear.

The neck was of figured maple if the design was simple, or of plainer wood if elaborately carved.

Materials (Continued)

Blocks and linings were made of spruce or willow. The back brace, bass bar, and sound post were spruce.

The bridge was spotted maple.

The fingerboard and tailpiece were solid ebony or maple veneered with ebony or rosewood. The pegs were ebony, rosewood, boxwood or maple.

All of the wood was quarter sawn or split, with the exception of the plank sawn bass bar. When the bass bar was mounted, its grain was then in the same direction as the quarter sawn belly.

Glue

In the ancient days of viol building, the makers were not faced with the bewildering choice of glues that we have now. They used hide glue, because that was the best (and almost the only) one available. Just because it's old, don't think that hide glue isn't good. I've seen crossbows, strong enough to send a bolt through a suit of armor, where the bow laminations were made up with hide glue, and they still pull to maximum without coming apart. True, it's not waterproof, but that only matters if you play your viol in the shower to accompany your singing.

You should use hide glue to put the belly on, so that it can be removed for graduating or for repairs. And since you are using it on some of the viol, it's no great inconvenience to use it for all. Whatever glue you use for the rest of the viol, it should be very strong, and not creep under pressure.

Hide glue, made of animal hide, sinews, hoofs, and bones, has been used by musical instrument makers for several hundred years. It comes in several grades and is supplied in powder, granular, flake, or chip form. It must be mixed with water in a glue pot, heated to a temperature of 140-150 degrees F., and applied hot. Thermostatically controlled electric glue pots are available, but an old kitchen type double boiler or simply a tin can immersed in a pot of water, will work quite well. Hot glue does

Glue (Continued)

not have a long working time. It begins to harden and set up as it cools and the surfaces to be glued must be brought into contact quickly and clamped. Allow about twenty-four hours for drying.

Liquid hide glue is also available in ready-to-use form and has generally the same qualities as the hot glue without the elaborate preparation requirements. It sets up slowly, allowing plenty of time for application and assembly before clamping. Here again, allow about twenty-four hours for drying. I recommend the Franklin liquid hide glue. It is easy to use and has excellent bonding strength.

While I recommend that you stay with the traditional hide glue in constructing the viola, there are three other glue joints where a deviation may be in order. This is where the neck joins the body, the hook-bar, and the belly and back center joints. Here transparent epoxy resin glue can be used. It comes in two small tubes, one a resin and the other a catalyst or hardener. It is mixed together in equal parts, applied to each surface to be glued and allowed to cure for about twenty-four hours. Little or no clamping is required and it makes a bond of outstanding strength.

Do not, under any circumstances, use Elmers, Bordens, or any other white glue. These glues are not creep resistant. Some other satisfactory glues for all but the belly to rib joint are Weldwood and Titebond.

FINISH

Much can be (and has been) said about the probable contents of the great (and not so great) finishes on the old musical instruments. I've probably seen a round half dozen formulas purporting to be the exact duplicate of that used by Stradivari (Amati, Stainer, Ruggieri, et. al.). Whatever was put on may forever remain a mystery, unless someone is willing to subject a valuable example to a rather extensive chemical analysis.

Whatever finish the old masters used, they used well. They were careful craftsmen, and worked for posterity. They used the best available, and if they were around today would probably use some of the modern materials that we scorn as "untraditional".

4. EQUIPMENT

HAND OR MACHINE TOOLS

The decision whether to use hand or machine tools often comes down to what you have on hand (or how lazy you are). The construction of a good viola da gamba is possible with no machine tools at all. After all, the old masters had none. But nothing is really gained by laboriously hand sawing out a neck, or hand jointing a belly, when a perfectly good band saw or joiner is at hand. Where the hand work should be applied is where it really counts; graduating a belly, purfling, or applying the finish. Here machine tools can't do the job as well as an educated ear, or a sensitive touch.

The use of a band saw is advisable when sawing out the neck, and the body mold, to assure that the cuts are at 90 degrees to the other reference surfaces. This is very difficult with the best of frame or coping saws.

The center join of the belly and back can be fitted with a joiner, or can be done with a long hand plane by the technique known as "shooting" an edge.

Common Tools

A list of common hand tools that I've found useful follows:

- Jack plane - joining short edges, preliminary planing of flat surfaces.
- Joiner plane - joining long edges, finish planing belly undersurface after gluing center joint.
- Coping saw - cutting outline of belly and back.
- Back saw - one of the most useful tools; you should have one fine and one medium pitch, if possible.
- Parallel clamps - two 12-inch ones, for general all-around clamping jobs.
- C-Clamps - two 4-inch and two 2-inch.
- Straight gouge - a five-sweep, 25 or 30 mm for roughing the outside and inside of the belly (sharpened out-cannel).
- Files and Rasps - the more different ones, the better!

Common Tools (Continued)

- Straight chisels - various widths, from 1/4" to 3/4".
- Scrapers - a selection of straight and convex edge cabinet maker's scrapers, for finishing and shaping.
- Carving chisels - used around the scroll, or if you decide to do a fancy scroll.
- Saber saw - cutting outline of belly and back.(Traditionalists may shudder at my choice of this tool, but I use it because I do better with it than with a coping saw. Use the finest pitch, narrowest, hollow ground blade you can find for this work.)

Special Tools

Some special tools are either convenient or necessary for the construction of the viola da gamba. They are as follows:

- Straight gouge - a five-sweep, 15 or 20 mm in-cannel gouge does wonders on cross grain work, as in shaping the belly in the area of the center bouts.
- Cabinet Scraper
- Toothed Plane - these two tools are used to bring the rather broad pieces of wood down to proper thickness for sides and back. It's possible to do it with jack plane and hand scraper, but it's a lot harder!
- Curved bottom instrument makers or "finger" plane - a 25 mm sole length, with blades about 1/2" wide. A toothed blade for roughing is a must, with a second smoothing blade a useful option.
- Peg hole reamer - used for finish reaming peg hole. Rough reaming can be done with two sizes of drill bits.
- Purfling tools - consist of a purfling cutter, adjustable, to mark the inside and outside limits of the groove; a sharp knife to deepen these marks, and a thin chisel to remove the wood between these marks to the proper depth.
- Screw clamps - for clamping belly and back to sides. These are identical with violin clamps, except that they must be able to clamp across three inches for a treble viol. (Some violin clamps will open this far.)
- Bending iron - for bending the wetted pieces of wood for the sides. A fairly sturdy iron must be used, as viola sides are about twice as thick as violin sides.

• Gauging or graduating calipers - used for measuring the thickness of the belly when scooping out the inside. If you already have some for violin, these are long enough for a treble viol.

• Sound post setter - used to manipulate the sound post into position inside the body. A violin size will do.

When I recommend a given tool for a job, it is just that, a recommendation only. If you aren't equipped already with a good selection of hand tools, and intend to build just one viol, you'll probably do like I do under those circumstances - make do with what you have. If you are an experienced violin builder, you may have better tools than those I've recommended, or different ways of doing these similar tasks - good enough. I learn a new, or better, (or worse) way of doing something every week. It's said that we learn from our mistakes; sometimes all I seem to learn is that I've made another one.

JIGS, FIXTURES AND MOLDS

Mold

There are two general types of mold, the outside (inside which the sides are constructed) and the inside (where the sides are steamed and bent around the outside). I personally have had no experience with an outside mold in the construction of a viol, plus there are definite advantages in the use of an inside mold which I will describe later.

The inside mold can be divided further into plank molds and full body molds. The difference is in the thickness of the material used to make the mold. A plank mold is one piece, and relatively thin in comparison to the width of the ribs. They are useful in very large sizes, to cut down the weight of the mold. Their disadvantage is that the ribs, after bending, tend to curl inward at the edges from lack of support. The weight of a full body mold in a treble size is not so great as to cause difficulty in handling.

Mold (Continued)

One of the best full body molds is that described in Wakes[1] book, pages 5-13, in great detail. This mold is built in two halves, an upper and a lower, which are held together with screws. The mold I use differs from Wake's, in that I detach the lower half of the mold instead of the upper. With this technique, the linings for the back, and the back itself, can be glued on before removing this assembly from the mold. This helps the sides to maintain their shape. The mold may be constructed as follows:

1. Cut a half pattern of the mold outline (Drawing No. 2) out of thin sheet metal or heavy artists board.

2. Prepare a sandwich of pieces of plywood, or warp-free pine or fir 2x10's, approximately 16 inches long by 11 inches wide by 2-1/2 inches thick. Draw a center line down one of the broad faces. (See also note after step 7.)

3. Lay the half pattern on the center line, approximately one inch in from the end at the tail end, and draw the outline. Flip the pattern over and draw in the other half. (This assures that the mold is symmetrical.)

4. Using Drawing No. 1, locate the holes for the clamps, screws, and blocks. Drill the screw holes and screw the sandwich together tightly. Drill the clamps and block holes.

5. Draw in the cutouts for the blocks, using Drawing No. 1. Note that these cutouts leave a portion of the holes at their corners. These holes are to assist in freeing the blocks after gluing up the sides.

6. Saw out the mold complete with cutouts for the blocks. Saw the pieces out carefully for the clamp blocks.

7. Plane or joint the mold down to a thickness of 2-3/8 inches. NOTE: The parting line between mold halves should lie above the angled juncture of back and neck block (see Figure 4-1). The rough sandwich may have to be planed on both sides to achieve this. Sink the screws or bolts holding the two halves together so that the plane or joiner doesn't hit the heads or points.

8. Mark the angle of the upper back and cut off the mold to this line.

9. File the upper bouts to meet the angle of the neck sides.

Mold (Continued)

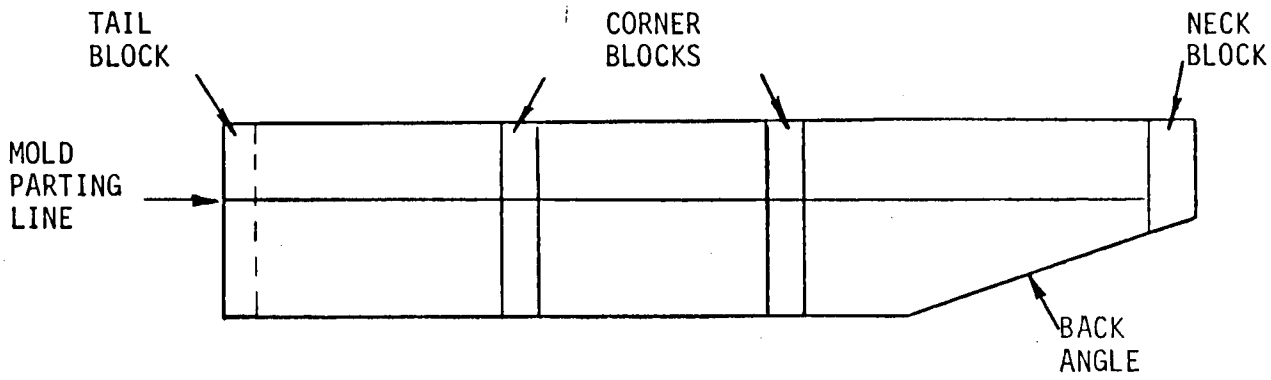


Figure 4-1. Mold Parting Line

10. Saw the clamping blocks out of the scrap from the sandwich (see Drawing No. 1). Glue the two pieces of each clamp block together in alignment. NOTE: Check the center bout clamp blocks for fit with a full length shim the thickness of the finished side. If the saw kerf was too narrow, they may have to be filed to clear. The upper (neck) clamp blocks will have to be angled to fit the mold as filed in step 9.

11. Prepare a clamping arrangement for each clamp block as suggested in Figure 4-2.

12. The edges of the mold can be sanded or filed if the sawing left them rough, but take care to keep them square with the top and bottom.

13. The mold edges should be varnished or waxed, especially near the blocks, to keep the glue from cementing the sides firmly to the mold. (If you can't get the mold out of the finished sides, it makes for a dull sounding viol!)

Mold (Continued)

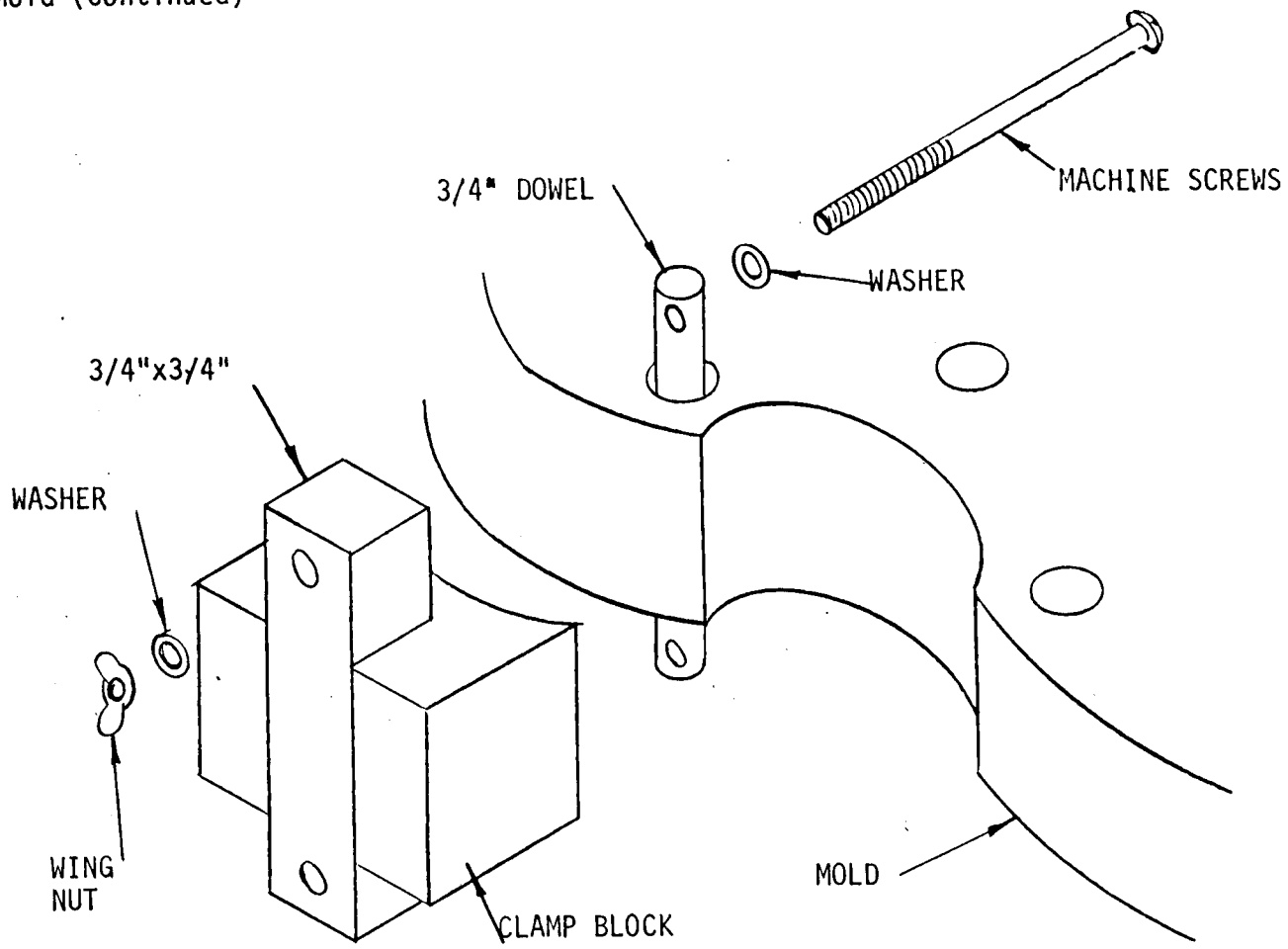


Figure 4-2. Clamp Arrangement

Screw Clamps

At least 28 screw clamps should be made. Figure 4-3 shows some of the various ways that this can be done. Type A is the least expensive, type C is the most convenient. The leather washers serve to protect the edges of the belly or back from marring, and, if made of a soft or "rough out" leather will keep the clamps from slipping. Cork disks may also be used, but felt is too soft.

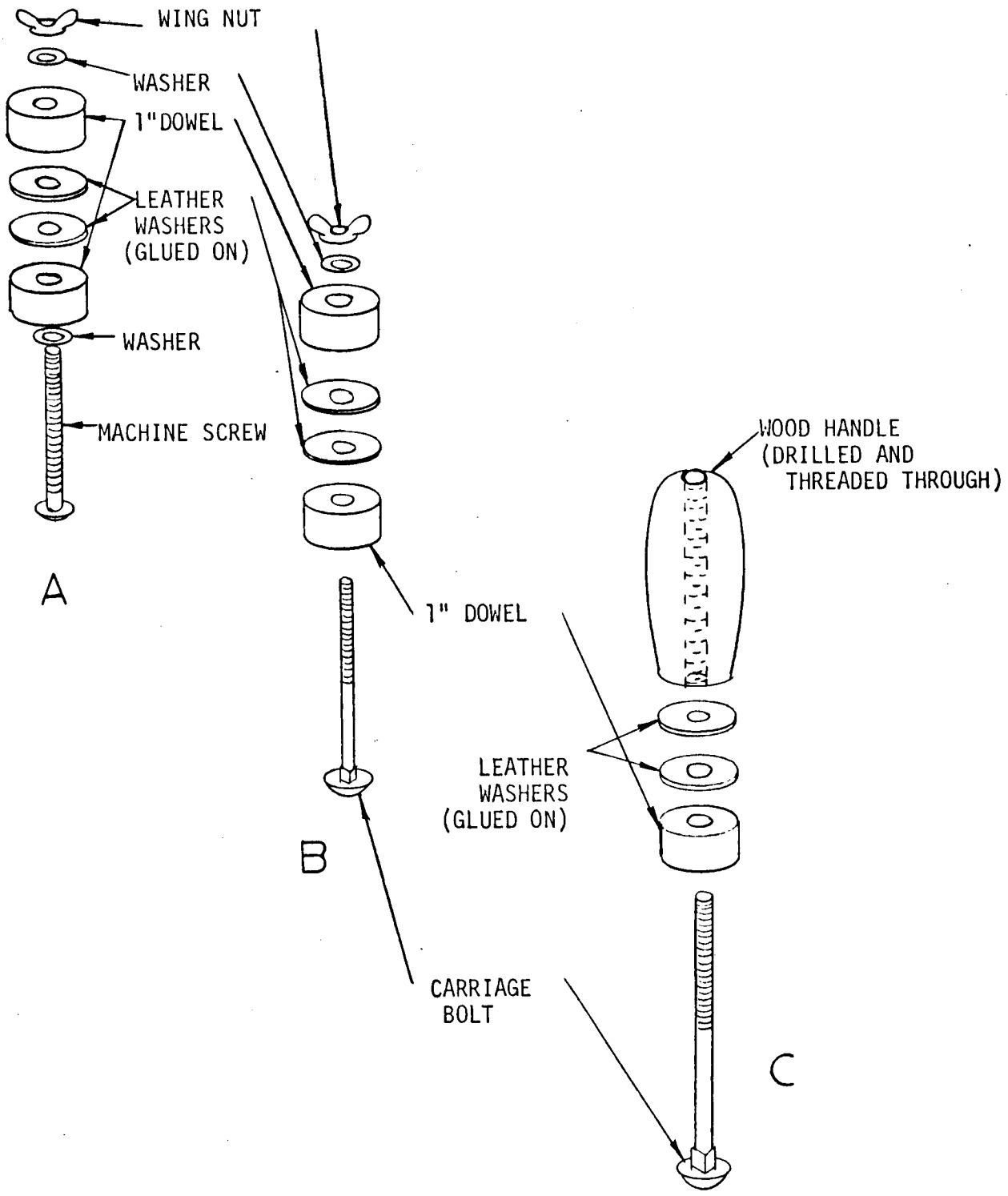


Figure 4-3. Screw Clamps

Neck Clamps

Figure 4-4 shows a technique of clamping the neck for gluing. This is a difficult clamping job, but is more easily accomplished if the heel of the neck is left unfinished until after the neck is glued. Glue a scrap block on the back extension with thinned glue, with the weaker grain next to the back. This can easily be removed and the back sanded smooth after the clamps are removed.

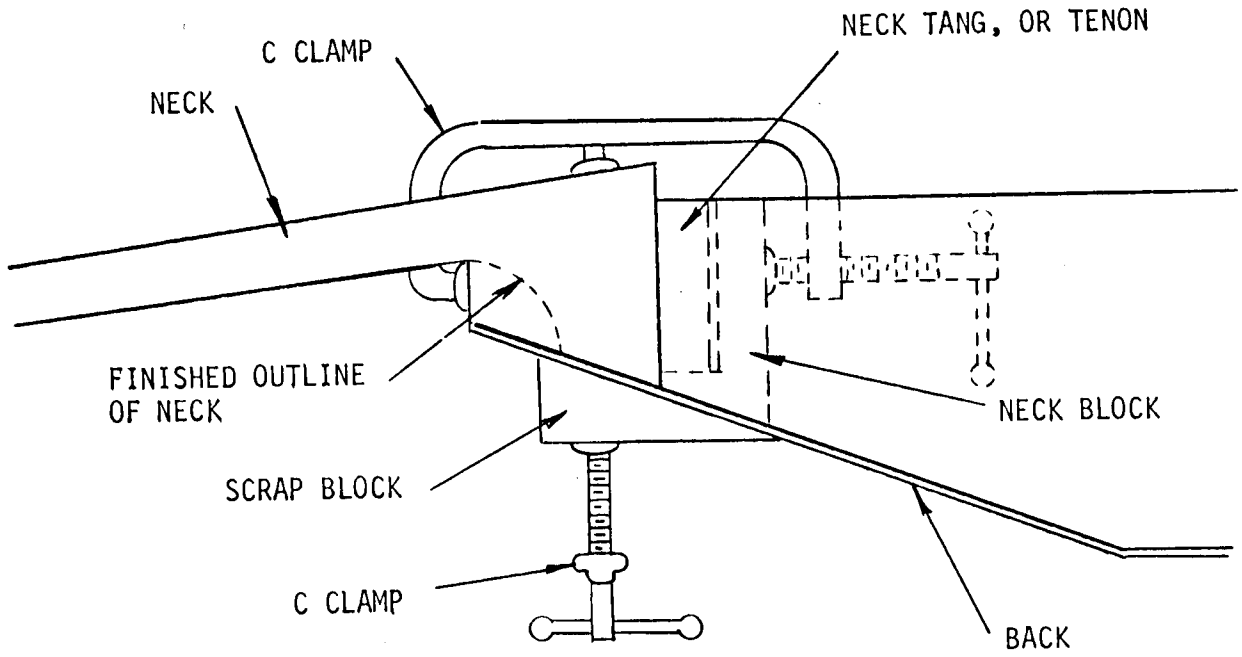


Figure 4-4. Neck Glueing Fixture

Neck Sawing Fixture

There is an optional fixture that can be built for sawing the base of the neck off to the proper angles (see Figure 4-5). Slot A is used to saw off the base of the neck relative to the upper (fingerboard) surface, slot B is used to saw off the base (back extension) surface relative to the base cut in slot A.

Neck Sawing Fixture (Continued)

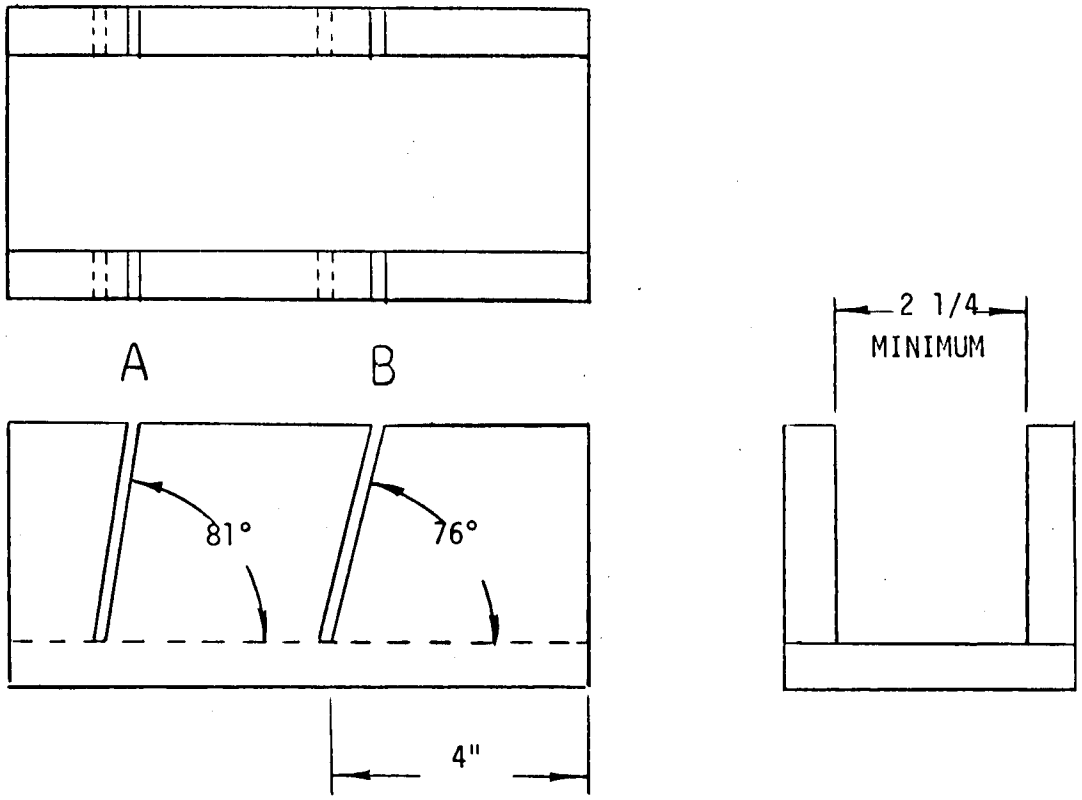


Figure 4-5. Neck Sawing Fixture

Bending Iron

There is a great deal of variety in the construction of bending irons. There are commercially available ones, but expensive; and I have seen some very ingenious home made ones. Heron-Allen[5] and older writers show a curved copper block which is heated in a fire, then clamped in a vise to use (see Figure 4-6A). Current bending irons are either electric or heated by means of a gas torch.

Brown[5] has some excellent photographs of an easily constructed gas-fired bender on pages 11, 12 and 14 of his book. A similar setup is shown in Figure 4-6B. Some sort of partial obstruction in the free end of the tube makes it heat more uniformly, and use less gas. One caution - your mounting bracket must be very sturdy, as the gamba sides are very hard to bend. There's nothing more invigorating than having a weak bracket fold up on you in the middle of bending a center bout, and having your knuckles run across a hot bending iron!

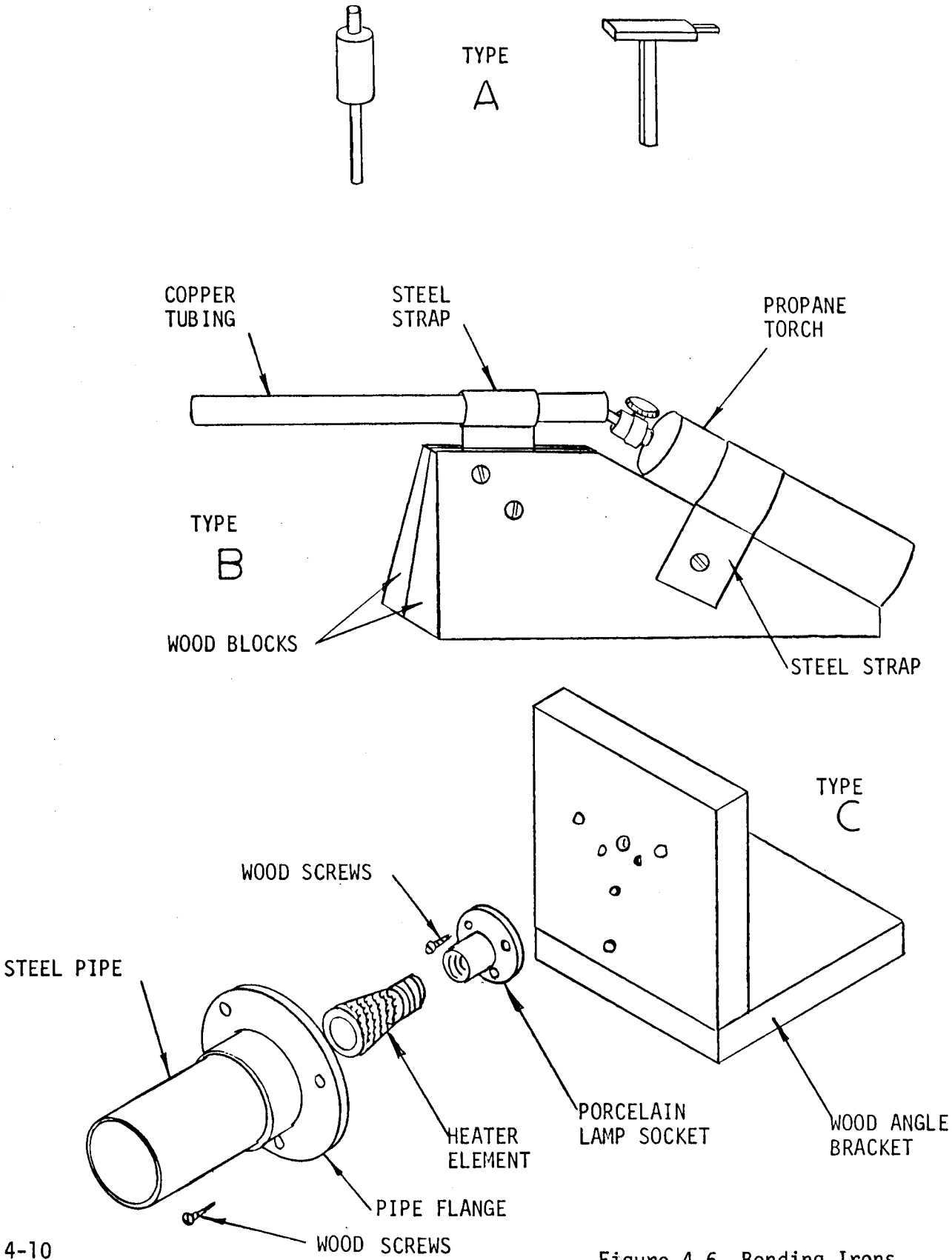


Figure 4-6. Bending Irons

Bending Iron (Continued)

The first electric bending iron that I made used a 300 watt soldering iron with a copper sleeve pressed on around the heating element. The shaft was clamped in a grooved block in a vise. This worked o.k. for violin sides, but didn't get quite hot enough for gamba center bouts. Wake has a design for electric irons on pages 17 to 20 of his violin book[1] and on pages 40-41 of his scrapbook[2]. He has instructions on how to get the patent drawings for his commercial bender, and makes a generous offer for anyone to take these drawings and build one. Figure 4-6C shows a very sturdy electric bender that may be easily built from parts available at any good hardware store. A rudimentary temperature control is also shown in Figure 4-7.

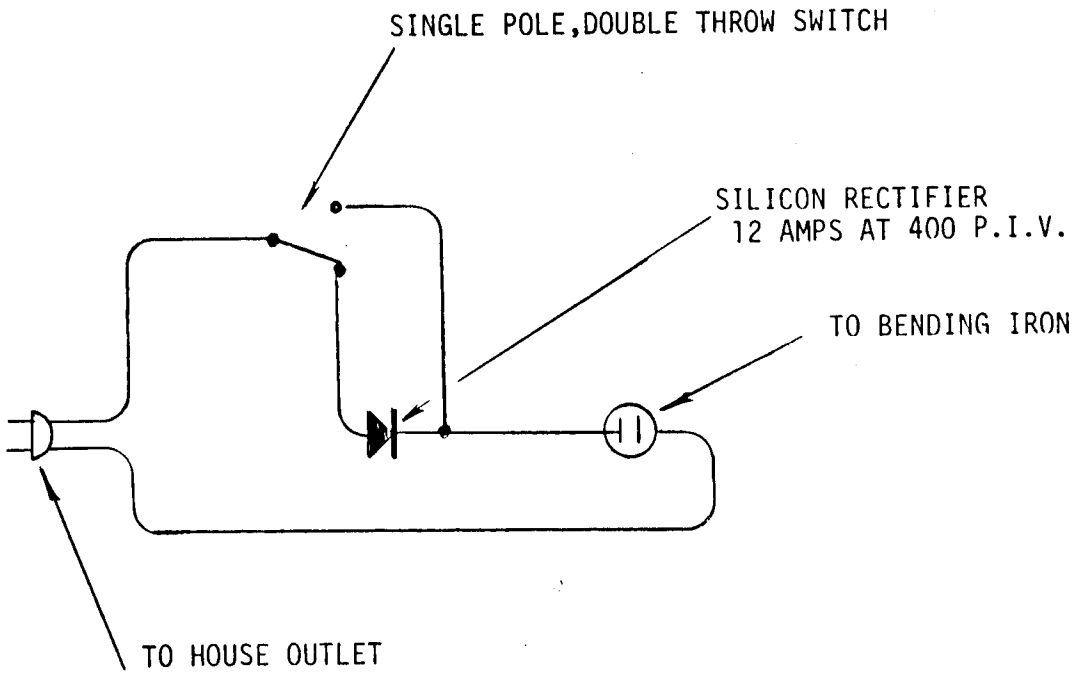


Figure 4-7. Bending Iron Temperature Control

Purfling Cutter

Simply stated, a purfling cutter is a device that is guided along the edge of a top or bottom plate, and scribes one or two lines at a time at a given spacing in from the reference edge. These lines are then deepened with a thin bladed knife, and the wood between them cut out with a thin chisel.

One of the simplest ones is described by Warnock[6], which relies on the thickness of the blade for the width of the groove; the bevelled blade being reversed to scribe the other line. A similar tool is shown on page 18 of Brown[3], where the second cut is achieved by moving over the blade with shims. Heron-Allen[5] illustrates a beautiful, old-fashioned, adjustable cutter on page 224, with little wedges and slides, similar in design to old marking gauges. It looks incredibly difficult to build, but I may make one some day just because it's so beautiful to behold.

If you wish to buy a purfling cutter, I can highly recommend the one designed by Irving Sloane[8], and available from the suppliers listed in the back of this book. If you decide to make your own, see Figure 4-8 for several models.

Purfling Chisel

A good purfling chisel is a must. Clearing that little groove properly is a job demanding a proper tool and much care. The one I use is an exact copy of the one in Heron-Allen[5], on page 224. It can be made by grinding it out of a piece of band saw blade (or possibly some power hacksaw blades). Old, worn out, band saw blades are a terrific source of material for small carving chisels and scrapers. They can be used as-is, without tempering, if you are careful not to overheat them while grinding them. After shaping the purfling chisel, carefully hone it as sharp as you can get it. You may have to make a couple of them before you get the edge angle just right. See Figure 4-9 for details.

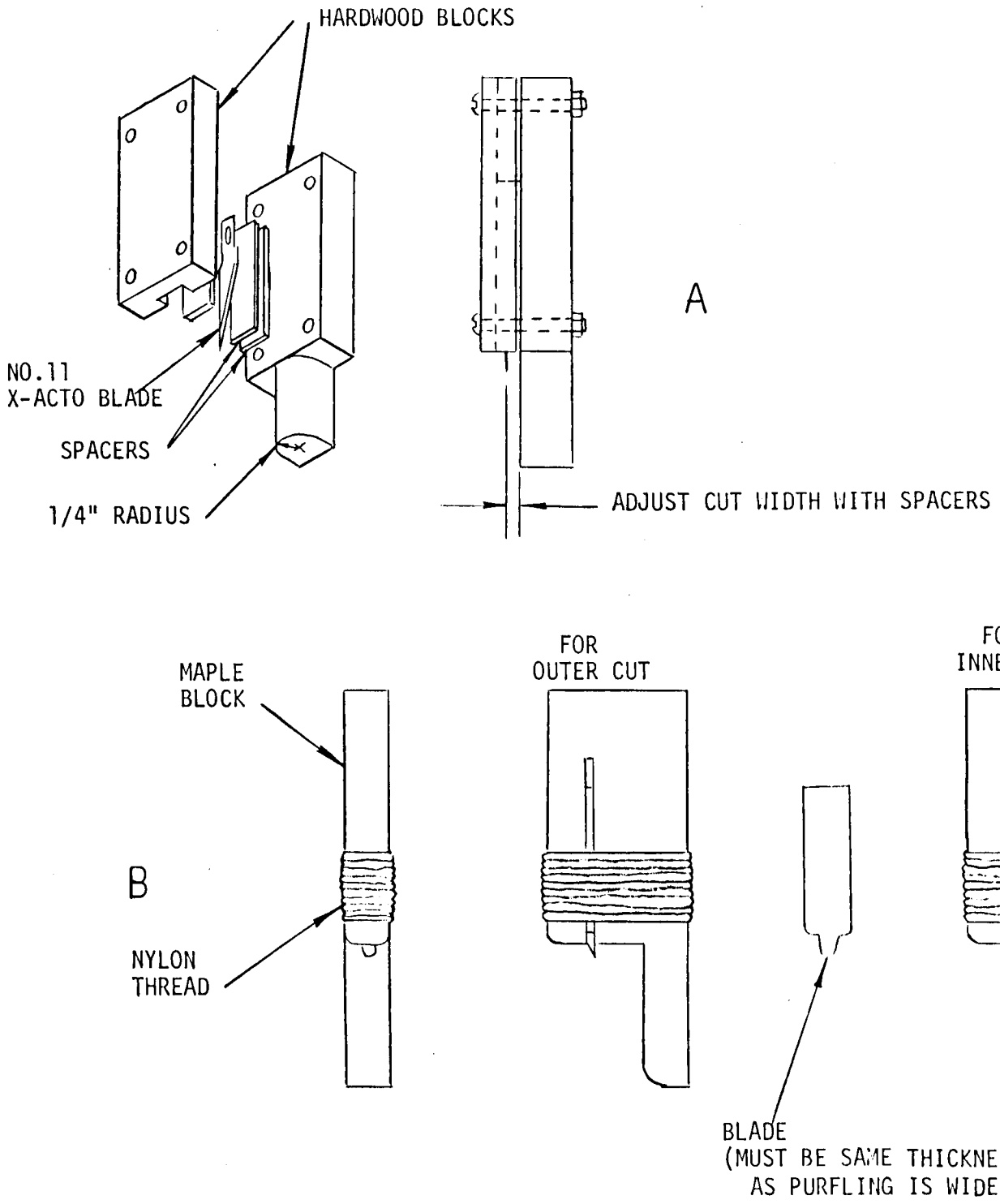


Figure 4-8. Purfling Cutters

Purfling Chisel (Continued)

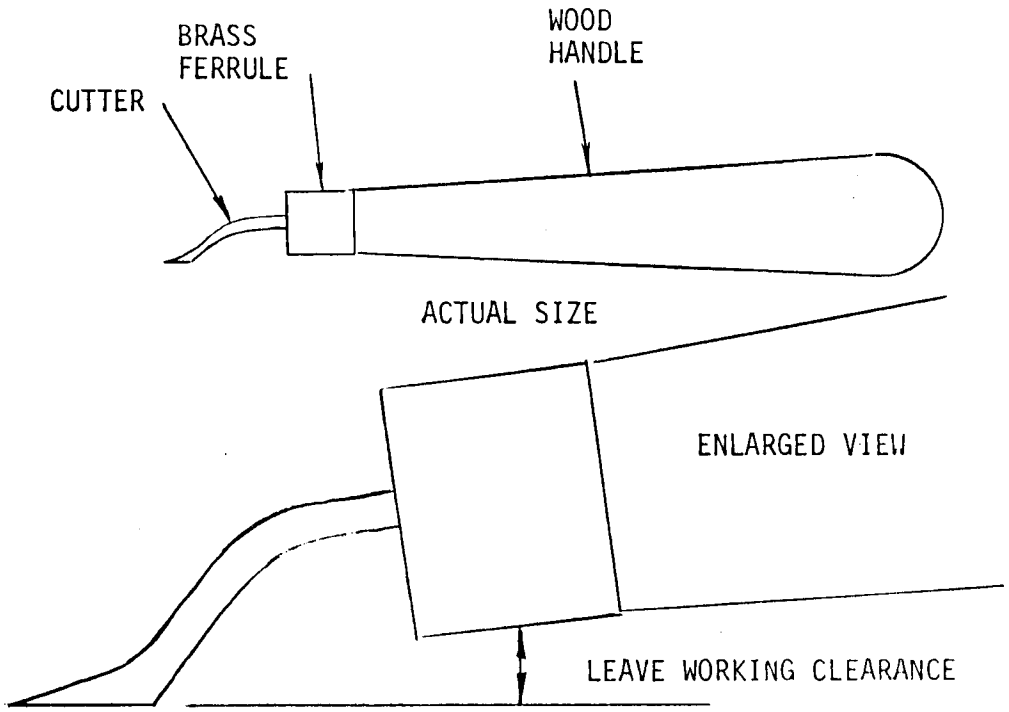


Figure 4-9. Purfling Chisel

PATTERNS

Full size drawings of all the parts, molds, and templates are included at the back of this book. They are printed on vellum paper, so that working blueprints may be made from them. Lacking access to a blueprint or copy machine, they can be traced, using carbon paper. A trick that I use, is to sharpen a hardwood dowel in a pencil sharpener, round the end very slightly with sandpaper, and use it instead of a pencil to trace over the lines on the original copy.

The pattern for the outline of the belly and back is of the most use in figuring out where, on a piece of wood, you want to cut for best figure or least defects. Because the sides never quite come out exactly like the drawing, it's better to trace the cutting line off the completed sides while they are still on the mold. Remember, there is no overhang; the edges are flush. Cut a little over, and finish after gluing. There is another caution to observe on the back; because of the angle of the upper back, the developed length is longer, and the outside contour is not the same as the plan view.

Patterns (Continued)

The neck plan may be cut out and traced onto the wood or glued on. If it is cut out, make little holes around the curl of the scroll, so that little dots can be made with a pencil, to be connected freehand later.

The arching templates should be traced onto a fairly stiff material (illustrator's board, thin aluminum, or thin wood) so that they don't flop around when you're trying to hold them on a line.

The graduating, or thickness, contour lines can be traced on the wood by eye, or the pattern can be punched along the lines with a pencil point, and the lines constructed along the dots freehand.

MEASUREMENT EQUIPMENT

The one piece of measurement equipment that is uncommon is the graduating caliper. If you have been building violins and have a satisfactory caliper, you're all set. If not, Figure 4-10 shows a few different versions. Type A I have included mostly for interest, it is the graduating caliper used by Antonio Stradivarius. Type C is easily made from scrap aluminum or heavy steel sheet, but is difficult to accurately calibrate. Type B is similar to those in Heron-Allen[5] and Brown's[3] books. Type D utilizes a fairly expensive dial indicator and can be purchased commercially from Woodcraft, made with an aluminum frame. If you build D, don't get a dial indicator with too fine a scale; it will drive you crazy chasing that pointer over large excursions of the dial. What you're trying to do with this instrument is get close to the norm for thickness, then to tune the belly by other methods.

Another handy measurement tool is a good two or three foot steel rule, graduated in inches on one side, and millimeters and centimeters on the other.

You will also need a protractor and angle gage or machinists combination square with protractor for the neck, fingerboard, and string angles.

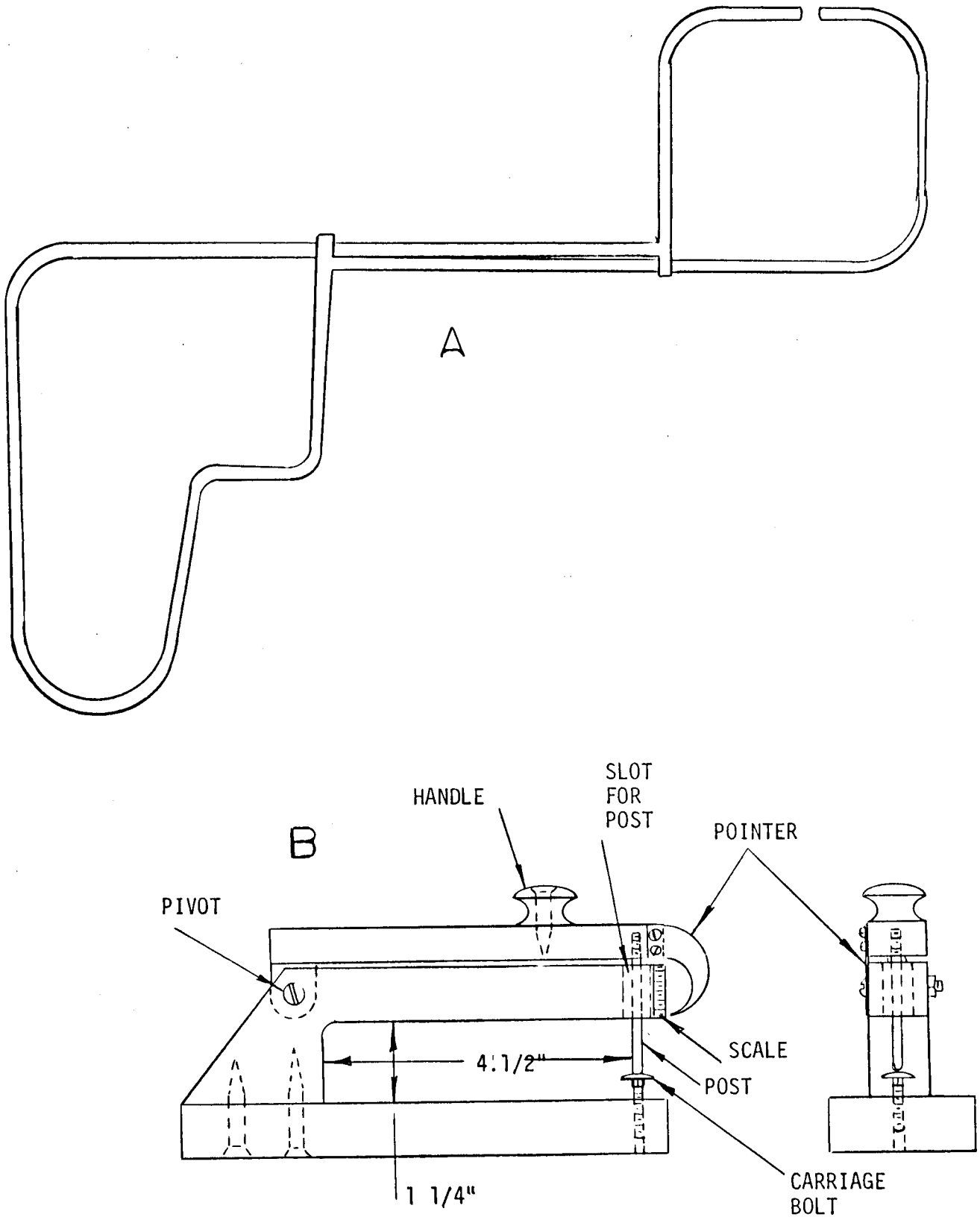


Figure 4-10A. Graduating Calipers

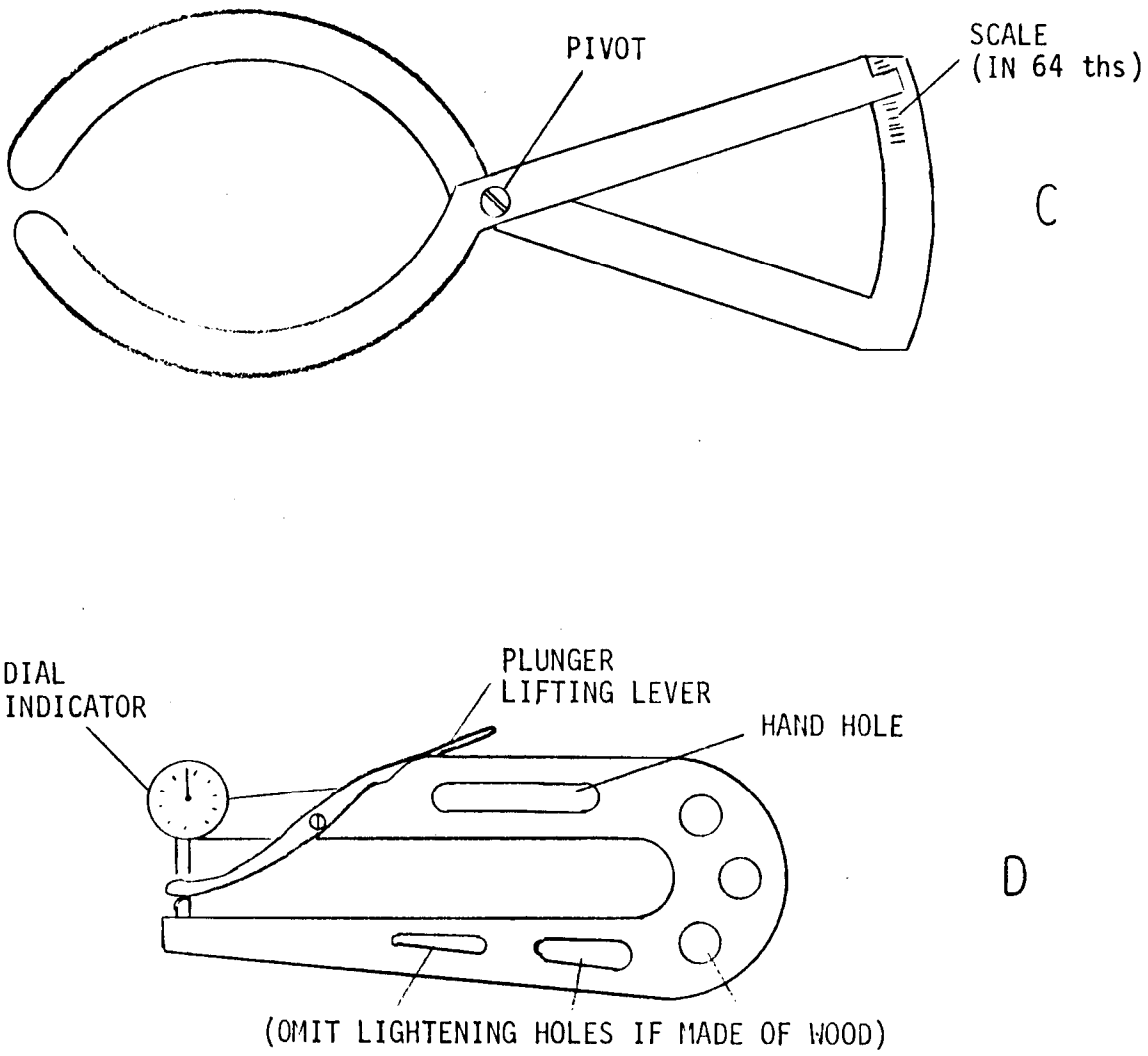


Figure 4-10B. Graduating Calipers

5. CONSTRUCTION (BUILDING)

BUILDING THE RIBS

The rib assembly consists of the end and corner blocks, the ribs themselves, and the linings. This assembly is built up on the mold. The rib sections are bent to shape with heat, using a bending iron.

Blocks

First, prepare the mold and blocks. Cut small blocks of straight grained spruce to fit the six cutouts in the mold. The grain should run from top to bottom of the blocks. When a close fit has been obtained, glue the blocks in the recesses with paper or thin cardboard between the joints. NOTE: Glue blocks to upper half of mold, only! This paper or cardboard makes it easy to break the blocks loose when releasing the rib assembly from the mold. The block should be a little longer than the mold is thick. When the glue has set, plane or file the ends of the blocks flush with the mold.

Place the mold half pattern (Drawing No. 2) on the mold, and complete the outline over the blocks, top and bottom. Carve, file, plane, or sand the blocks to this contour. Extend the mold centerline across top and bottom blocks.

Ribs

The ribs are made of wood that is sawed or split on the quarter. That is, the edge grain runs the length of the piece and shows on the broad faces, at right angles to the width. Quartered wood is preferred for ribs to plank or slab sawn wood because its dimensional change across the length of grain (width of piece) is minimum with changes in humidity. I believe that the fancy grain is more prominent in wood that is quartered, also. (See Figure 5-1 for illustration of quartered wood.)

Originally, wood for ribs and back was split out from the log or block, then brought to thickness with drawknife, plane, and scrapers. This is the tough way to do it, but it has the advantage that the grain runs with the thickness of the piece. Old-time furniture makers did each piece this way, and their stuff has warped less in two hundred years than current factory built stuff will in two years. See Heron-Allen[5] page 133 for a good description of quartered wood.

Ribs (Continued)

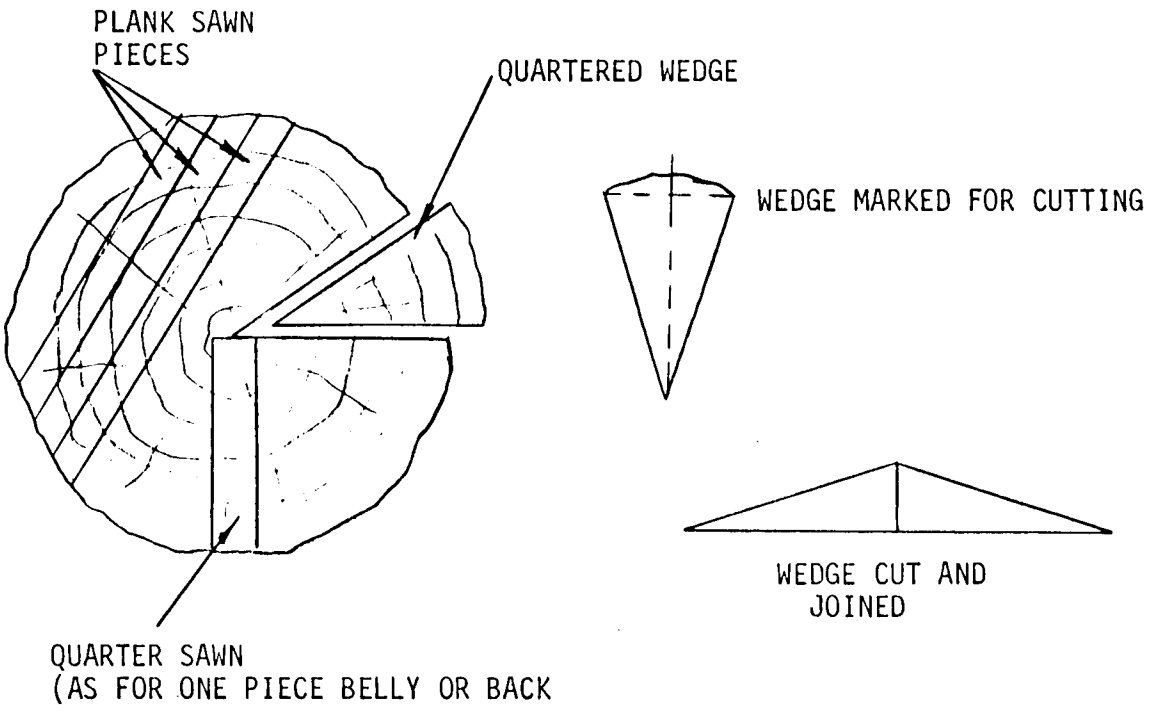


Figure 5-1. Quartered Wood

You can plane one side of a quartered chunk, then saw off a slice; plane the chunk again, saw off another slice; and so forth until you have enough (plus some for mistakes). That way you end up with one face smooth, and you only have one to finish.

The easiest way is to buy a set of nice cello ribs. This will give you enough wood for ribs and back (with sufficient extra for a set of violin sides). The cello ribs are the exact thickness that you need, after scraping them to the required smoothness.

Finish the wood to the required width and thickness, and smooth inside and out. Leave it a little oversize on width. If the wood has rough saw marks inside, it will not bend to a smooth radius, and may even break at the marks. Cut the wood to length plus a half inch or so. (Measure around the mold with a flexible tape measure.)

Ribs (Continued)

NOTE

Here is where you must decide which side of the piece is inside and outside, and towards belly or back. Striped maple figure usually slants across the piece. This slant must be consistent on one side, and should slant in the same direction on both sides.

Soak the wood in hot water for at least fifteen minutes. Turn the bending iron on towards the end of the soaking period. Test the iron by dropping some water on it. The water should bounce and sizzle (same heat as for pancakes). You can also try a piece of scrap wood to see if it's too hot and will scorch. The best temperature is just below the scorching point.

Bend the center bouts first. They are the hardest, and should be clamped on the mold first, as the upper and lower bouts go over the end of the center (not mitered as in a violin). Press the wet rib to the hot iron, holding it in contact with a small block of wood, and gently rock it back and forth. As the water turns to steam, the wood begins to soften, and the rib can be bent into shape. Keep trying it against the mold. Don't force it, just keep pressing slowly and deliberately, frequently dipping the rib in water, until the correct shape is obtained. Clamp the rib in place right away, before it cools off very much. You can glue it to the corner blocks right away, or better yet let it cool and set up, and take it off later while you are doing the upper and lower bouts. When the bout is set, trim the excess down to the mold at the corners with back saw and in-cannel gouge.

Repeat the process with the upper and lower bouts. If you have a long enough piece, and if the figure runs straight up and down, you can bend the entire lower bout up of one piece instead of two. Otherwise you must fit the two lower bout pieces together with a neat butt joint exactly on the center line. If you must make any mistakes on this joint, try and make them on the upper part, as it gets cut away to fit the hook-bar.

Ribs (Continued)

Glue the center bouts to the corner blocks and trim them to the mold outline (if not already done). Glue and clamp the upper and lower bouts to their respective blocks. After the glue has set, trim the edges to the center bout and neck block with back saw and in-cannel gouge.

Cut the upper bouts off to the angle of the upper back, and bring the ribs down to the top and bottom of the mold with plane, file, and sandpaper on a long block.

Remove the screws holding the upper and lower halves of the mold together. Carefully pull the lower half of the mold out of the assembled ribs. If you didn't get too much glue where you didn't want it, it should slide out without too much trouble. Try prying between sides and mold, near the blocks, with a dull, thin table knife. It will sometimes make awful cracking and snapping noises, usually with no harm.

With a 1/2 inch straight chisel or the in-cannel gouge, shape the now accessible lower halves of the corner and bottom blocks to their finished inside contour.

Linings

The lining strips are prepared in the same way as are the sides. They may be split or quarter sawn from spruce or willow, then finished with a plane or scraper. There is usually enough scrap from the belly blank to furnish these. They should be smooth both sides, for a good glue joint and to prevent cracking while bending. The strips must be soaked in hot water, and bent over the hot iron in the same way that you did the sides. During bending, they can be held up to the inside of the ribs to check your progress.

When you fit the linings, you can mortise the ends into the corner blocks as was done by the old makers (see Figure 5-2A) or merely butt the ends tight (see Figure 5-2B). On old instruments, only the ends of the center bout linings were mortised; probably to keep them from popping out if the glue let go, because of the sharp bend.

Linings (Continued)

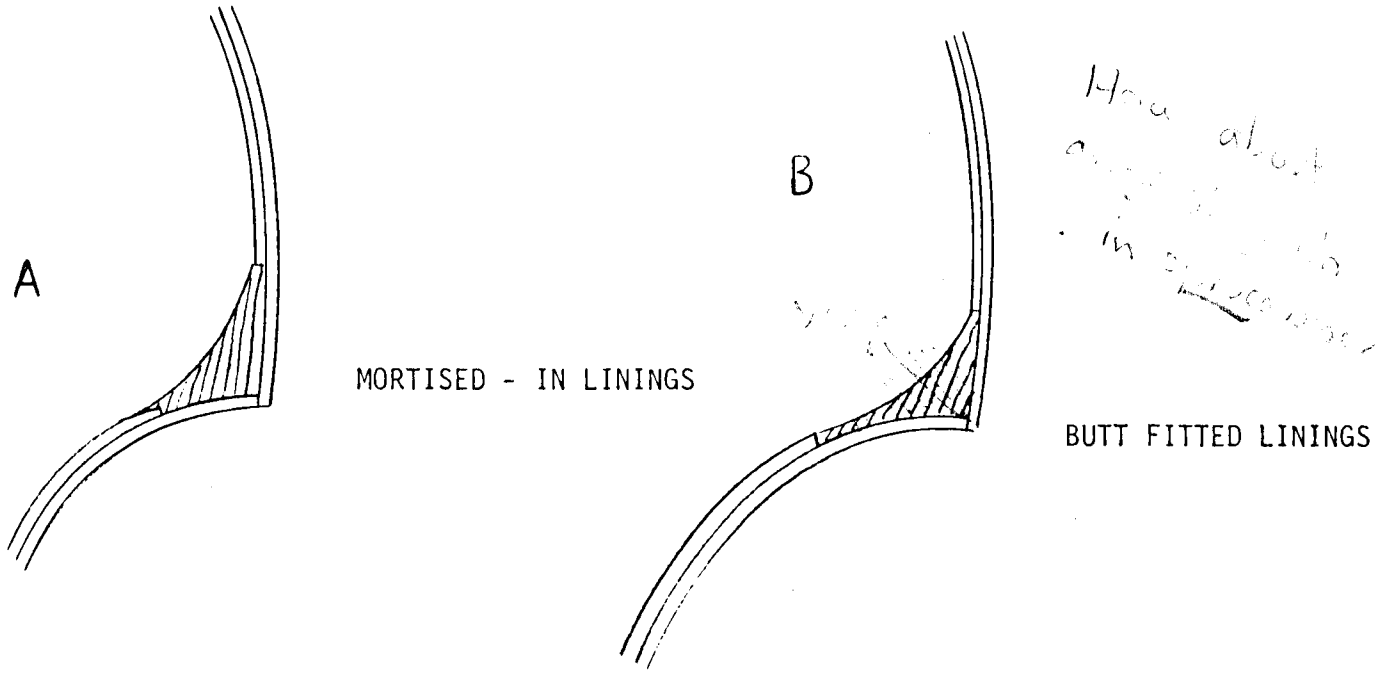


Figure 5-2. Fitting the Linings at the Corners

When they fit, glue them in place with the reference edge flush to the edge of the rib, or protruding very slightly. Clamp in place with good spring clothespins. If there are any buckles or humps where they don't fit tight to the rib, use a small C clamp at that spot.

After the glue sets up, remove the clamps and finish the linings flush with the ribs. Using a very sharp knife or chisel, chamfer the inside edge of the linings as shown on Drawing No. 4. "Size" or coat the top edges of ribs, linings, and blocks with thinned glue. The ribs are now finished as far as you can go, until the back is glued on.

BACK

The back is also made of quartered wood. It is usually made of two pieces, glued together in the center, and planed or scraped smooth. The two pieces are "book matched", as are violin backs. In other words, adjacent quartered pieces are used, so that the pattern (or stripe) matches on either side of the center joint. (See Figure 5-3).

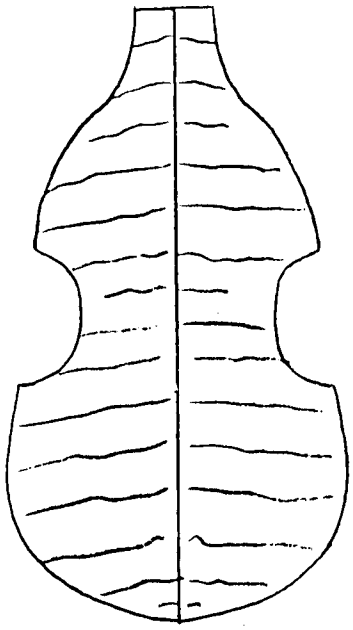


Figure 5-3. Book Matched Back

If you cut the pieces yourself, keep track of the two adjacent pieces, and which is the same end on both. If you buy matched cello ribs you will find that they are all adjacent; just pick two that look good together.

If you have split or sawn the pieces from a larger wedge, plane the two sides that were sawn apart flat for a reference surface, then work the pieces down almost to finish thickness before gluing them together. (Glue a shim on the thin side to level it, and run them through a joiner if you have one.) If you have purchased a set of pieces for a violin back, you can resaw thin slabs from them on a band saw; if not, you'll have to work the whole slab down to thickness.

Back (Continued)

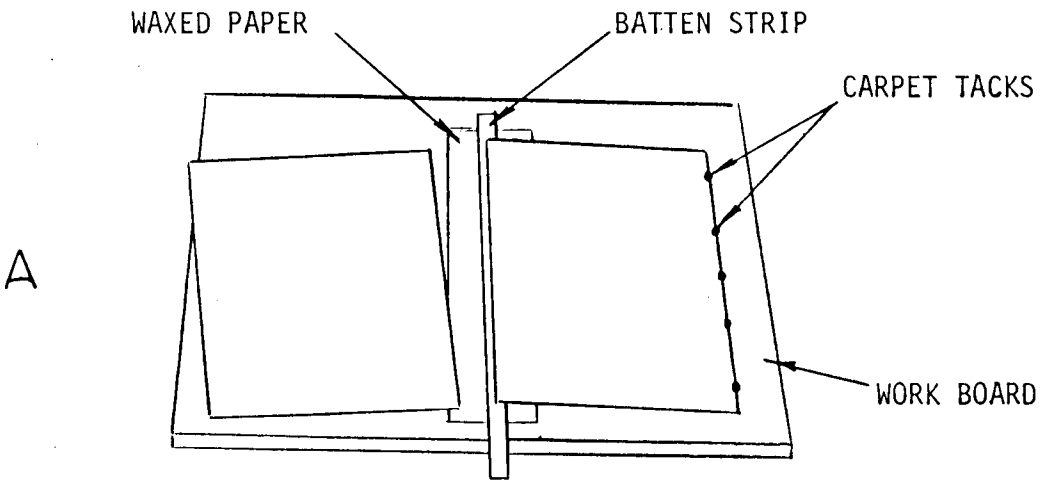
When you have the two pieces nearly to finished thickness, joint or shoot the two edges to be glued. When these two edges are held tightly together in front of a strong light, you should see no gaps. Don't depend on the glue to fill any holes, it's not structurally as strong as a well fitted glue joint.

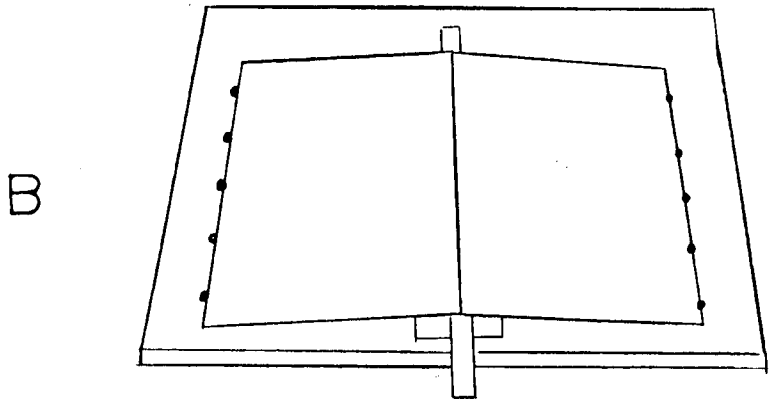
Cut a piece of 3/4 inch plywood or particle board that is nice and flat, big enough to lay the assembled back on, with enough edge around the back for clamping or fastening to your workbench. Lay a piece of waxed paper down the center, longer than the back. Lay a smooth wood or metal batten strip about 1/4 inch thick x 3/4 inch wide, and longer than the back on the center of the waxed paper. Lay one side of the back on the work board, with the edge to be glued centered on the batten strip (see Figure 5-4A). Drive several heavy carpet tacks down tight along the outside edge of the side. Position the other half of the back, with the edge to be glued butted tightly against the first piece (see Figure 5-4B). Drive tacks in along this edge, but not so the heads grip the piece. Lift off this side, coat the edge with glue (or epoxy), replace the piece, and drive the tacks all the way down. Place a strip of waxed paper over the joint and slide the batten strip out from under the joint. Press down the center joint and clamp with a heavy strip of wood to prevent bowing (see Figure 5-4C). Leave at least 24 hours to dry.

CAUTION

Before removing the clamps, take out the tacks from one side. This prevents the back from flying up in the center, and breaking the glue joint, or wood.

Take off the clamps, lift up the glued back, remove the waxed paper, drive the tacks down below the finished height of the back. Lay the back on the work board and drive tacks around the edge (not over) to keep the board from moving while you work on it. Keep the tack heads below finished thickness, so you don't hit them with the plane. Plane and scrape the back to finished thickness, working on both sides.





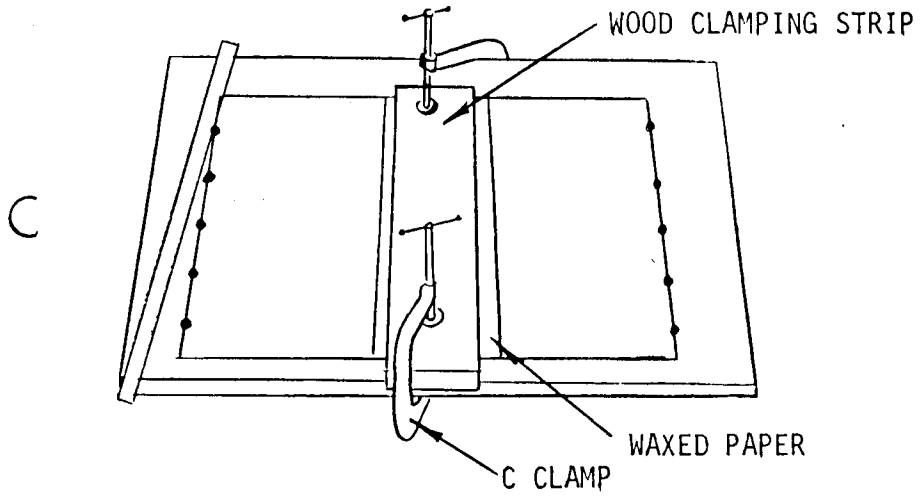


Figure 5-4. Glueing the Back Center Joint

Back (Continued)

Set the finished ribs (on the mold) on the inside of the back, with the center line of the ribs and mold on the center join of the back. Draw around the ribs, up as far as the taper to the neck. Mark this point. Carefully tip the ribs down to the back, and finish drawing the tapered portion. Draw a line across the back where the taper starts. Saw out the back, staying a little bit away from your line.

With a straight edge and sharp knife, cut a V shaped notch across the inside of the back on the bend line previously marked. Make the inside angle of this V cut the same as the bend angle, so that the cut just closes up when the back is bent up in place. Care in cutting this angle prevents the cut from showing at the edges of the back. Try not to cut all the way through the back; it can be glued back on, but it doesn't look as nice.

Lightly sand the bottom edges of the ribs and blocks, to remove any glue lumps from the sizing operation. Glue a wedge shaped scrap block on the back's neck extension, as shown in Figure 4-4.

NOTE

If the V cut is wetted slightly, it will bend more easily, and without cracking.

When the wedge block glue joint is dry, coat the bottom edge of the ribs and blocks with full strength glue, lay the belly in place with the center joint lined up with the center of the mold and ribs, and clamp it in place. Make sure there's a clamp on top of each corner and end block. Let it dry well, this is a glue job that should never have to come apart again.

Remove the clamps and work the overhanging edge down flush with chisel or knife, taking care not to mar the finish of the ribs. I usually save the final finishing until after the belly is glued on.

Back (Continued)

Tap the mold with a hammer next to each block until they are all loose from the mold. A thin, dull knife may be inserted into the paper or cardboard, starting at the holes, and some careful prying done. Lift the mold out of the ribs. Finish shaping the end and corner blocks. Fit linings to the belly edge in the same way that you did the back. Size the edges with thinned glue.

Cut out the spruce back brace, as shown on Drawing No. 4. Glue and clamp it into position on the inside of the back as shown on this drawing. Glue a 1-1/8" wide strip of linen across the inside of the back at the V groove, centered on the groove.

The back may be purfled at this time. Purfling is described in a later section of this chapter.

BELLY

Glueing Up (See Figure 5-5)

Unless you are using a one-piece belly, the two, book-matched, belly halves must now be jointed and glued together.

If you are splitting your wood from the quartered log (A and B), plane the flat surfaces smooth and level, with no wind or warp. A small strip or blocks may be glued on the narrow side to hold the piece level (C). Square the edge to this flat, and joint it so that no light can be seen through the joint (D). Be sure to plane away any sap stains or discolorations near the bark.

If you have purchased a set of pieces for a violin belly, separate them, plane the flats and joint the edges as above.

Now, if you have succeeded in making a center joint that looks perfect, it is possible to glue the two pieces together without clamping by a technique called "wringing". Clamp one piece in the bench vise with the edge to be glued up. Coat the edge with hide glue or epoxy. Bring both pieces together and press the upper piece down

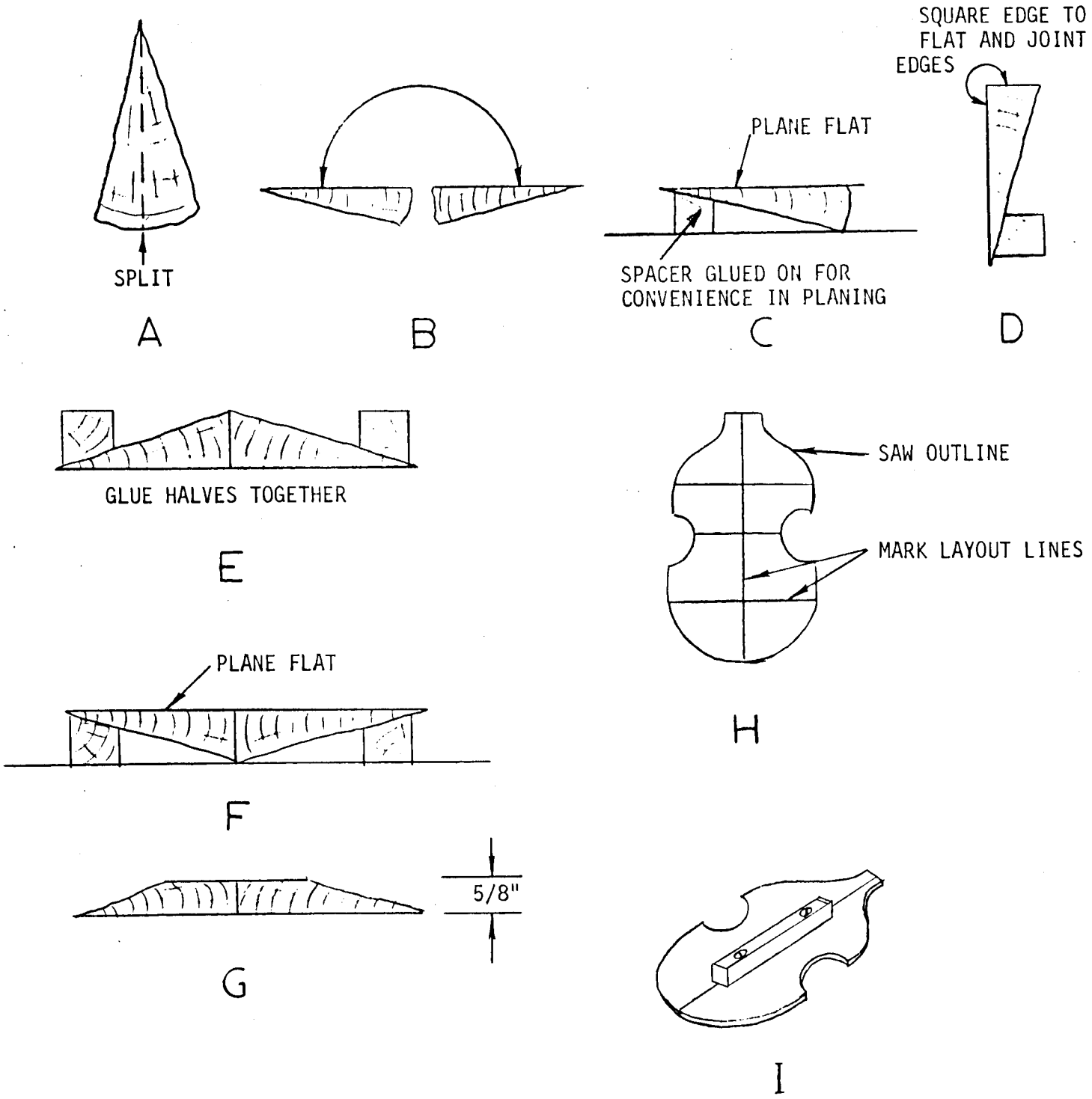


Figure 5-5. Belly Preparation

Glueing Up (Continued)

with a sliding motion, so that they line up exactly (E). Leave the pieces until the next day, and if you've done your work well, you have a perfect joint.

If you prefer to clamp the center joint, there are a number of techniques (see Figure 5-6). The big problem with clamping is that the center of the two pieces wants to pop up, thus opening the top of the joint. If this happens, wedge under the upper clamps as shown in A. If you use bar or pipe clamps, put two across the bottom and one across the top. You'll have the most trouble with wood that has been spit out, with irregular edges and top surfaces to work with. Violin pieces are usually sawn out with fairly regular surfaces and edges, and are easier to clamp (B). One trick to getting a tight joint is to have the ends touch, and a very small gap in the center, then, when you tighten the center clamp, the gap closes but the ends don't open up.

After the glue joint has set up, run your joiner plane (or the longest plane you've got) over the surface that will be the inside, to make it perfectly flat, with no wind or warp. Turn the piece over and plane it to a thickness of 5/8 inch (see Figure 5-5G).

Center the rib and back assembly on the inside surface of the belly blank, with the rib center line on the center join of the belly. Trace around the ribs on the belly. Saw out the belly, staying a little away from the line. Mark the arching guide lines across the top, bottom and edges of the blank (see Figure 5-5H, and Drawing No. 3) with soft black pencil.

Arching the Belly

Mark a line around the outside edge of the belly, 5/32 inch from, and parallel to, the inside surface. This line establishes the preliminary edge thickness of the plate. Take a wooden cleat, about 1" x 1" x 10" and screw it to the underside of the belly (see Figure 5-5I).

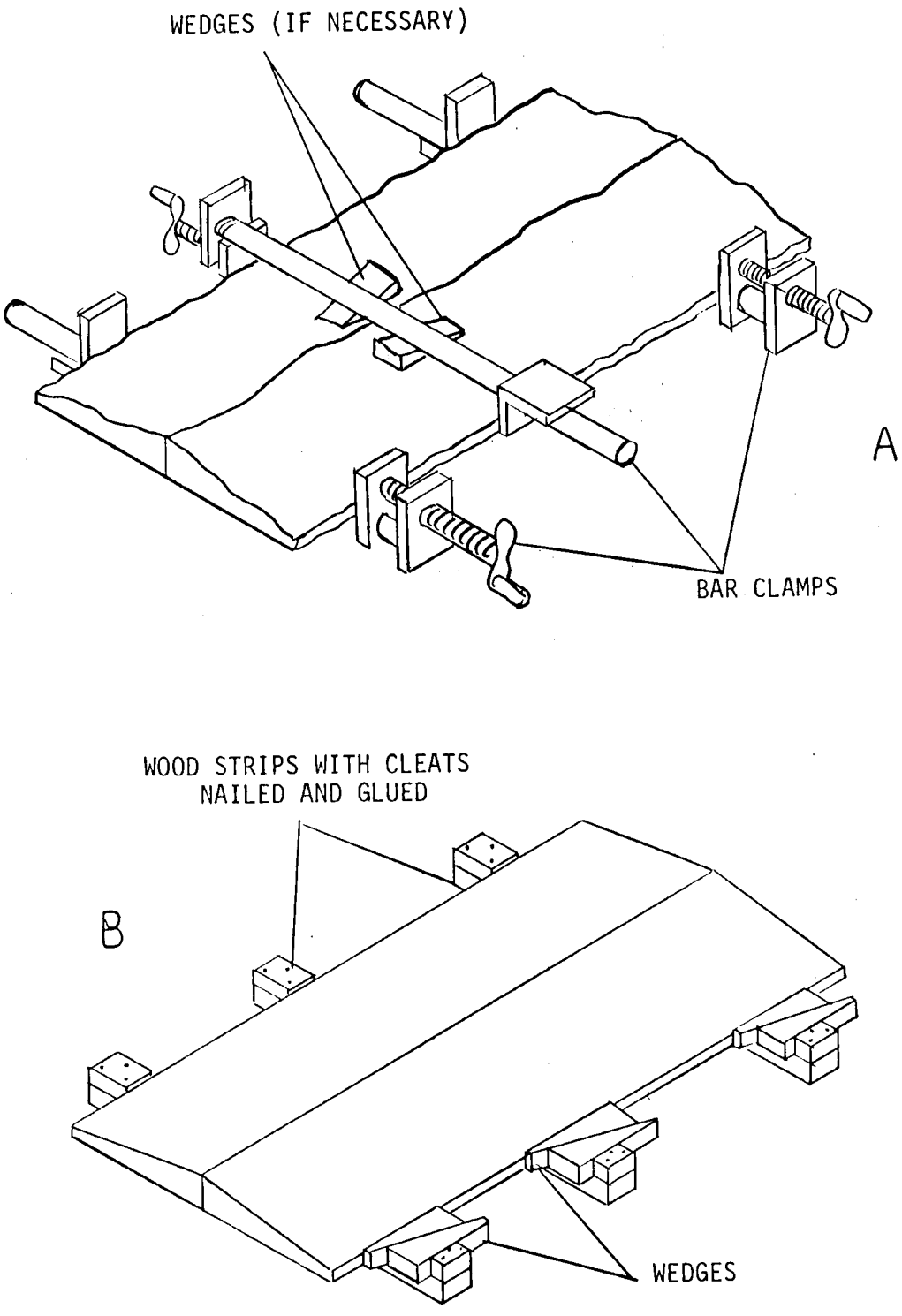


Figure 5-6. Clamping the Center Join of the Belly

Arching the Belly (Continued)

CAUTION

Choose screw locations and lengths that will place the screws in wood that will be later removed during the scooping out of the belly. Don't locate a screw right on the center join, as it may separate the glue joint.

Clamp the cleat in your bench vise to hold the belly for arching. Using a gouge, cut a channel along the center join to match the template for the lengthwise arch.

CAUTION

Make sure your template is marked as to neck and tail ends, and watch the marking when you're using it.

Leave a little material for finishing. Run your black pencil down this groove when finished. Gouge channels at the cross arching lines, using their templates. Again, redraw the reference lines at the bottom of the grooves. Now proceed to cut a flat ledge all around the plate, down to the line scribed around the edge. Carefully remove the excess wood between the grooves and the edge with chisels and finger plane. Finish smooth with curved cabinet scrapers. Very little sanding will be necessary after the scraping, until after filling the grain. Bring the edge down to the final 1/8 inch thickness.

Scooping the Belly

Remove the cleat from the underside of the belly. Lay the belly in a holding fixture or on a thickly padded bench top (see Figure 5-7), and mark the thickness graduations on the underside (see Drawing No. 3). Draw in the outline of the flat around the edge. With a gouge, carve a groove on the graduation lines down to the thicknesses shown on Drawing No. 3, using the graduating calipers often. (It's a lot easier

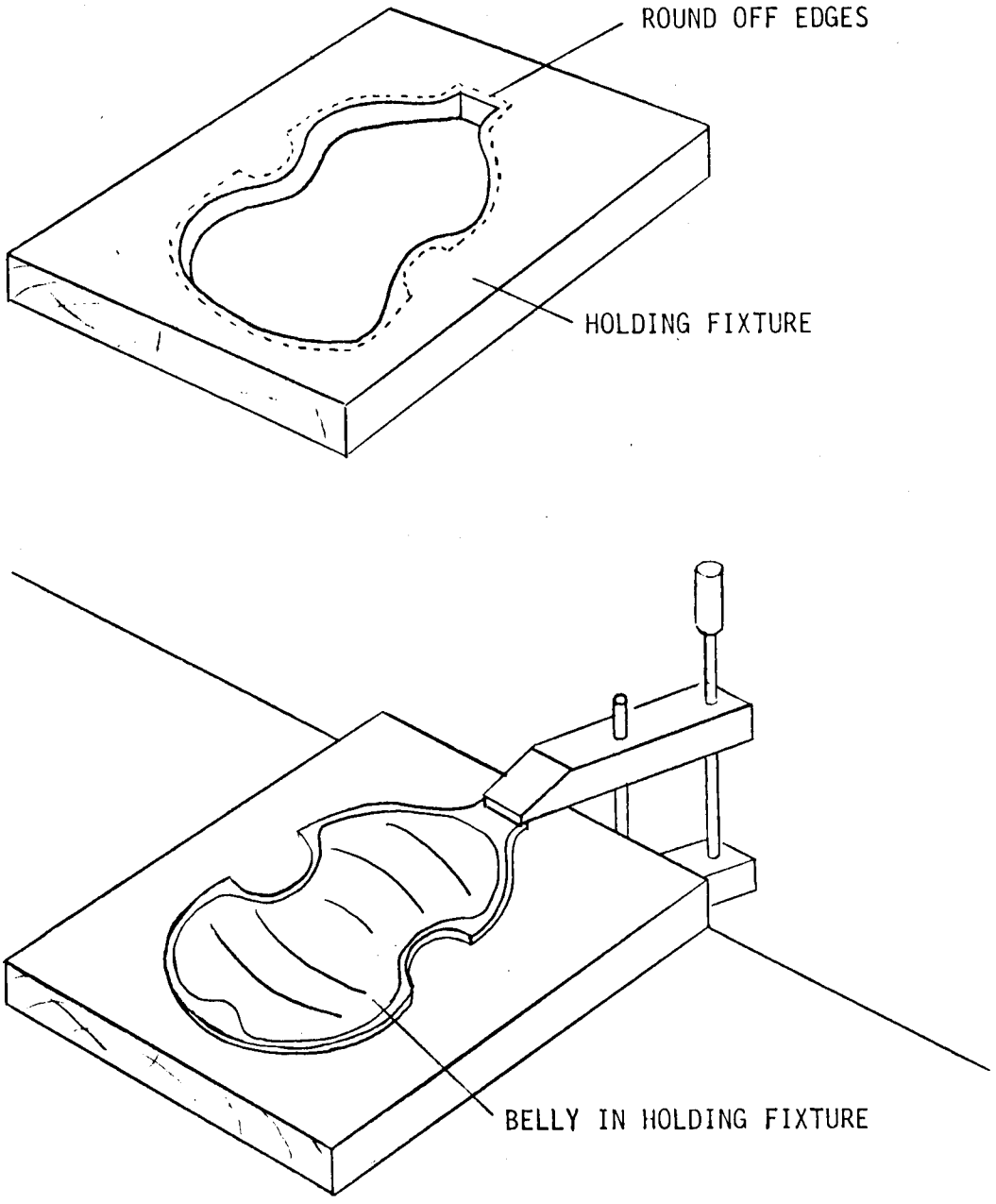


Figure 5-7. Scooping the Belly

Scooping the Belly (Continued)

to take a little more off, than to try and put some back on!) When you have the lines defining the thickness zones down almost to the proper thickness, stop, and draw the lines in again with a soft black pencil. With gouges and finger planes, and checking often with the graduating calipers, carve the hollow of the back from the flat around the edge smoothly down to the pencil lines. Leave the flats at the ends and corners for glueing the belly to the blocks. Finish smooth, and down to final thickness with curved scrapers.

Tuning the Belly

This is one of the most important steps in the construction of the instrument. Properly done, it can mean the difference between an indifferent instrument and one that sings! It also happens to be one of the most difficult steps to describe; being part skill, part experience, and part inspiration. Those of you who have built violins will find that it's essentially the "tap tone" technique, except that no reference is made to the tone of the back.

I must digress from construction techniques here, and go into a short lecture on physics. A viol belly is a vibrating plate, and like any vibrating body has a resonant frequency, and "nodes" or points where the vibration is a minimum or maximum. What you are going to do is hold the belly at one of the minimum nodes (where holding it will not interfere with the vibration) and tap or excite it at one of the maximum nodal points. Then, you will carefully scrape out the inside of the belly until you get a clear tone at about the right frequency (or note).

See Figure 5-8A. Hold the belly at point 1 firmly between thumb and forefinger, and let it hang down. Tap the belly at point 2, then at point 3. You should get a clear tone of around E or E flat at point 2 and one octave lower at point 3. If you don't get clear tones, start scraping the inside of the belly in the areas marked with double crosshatching in 5-8A (and on Drawing No. 4). Split up your scraping among the four areas.

NOTE

Removing wood will lower the tone.
If it's high, but clear, leave it alone.

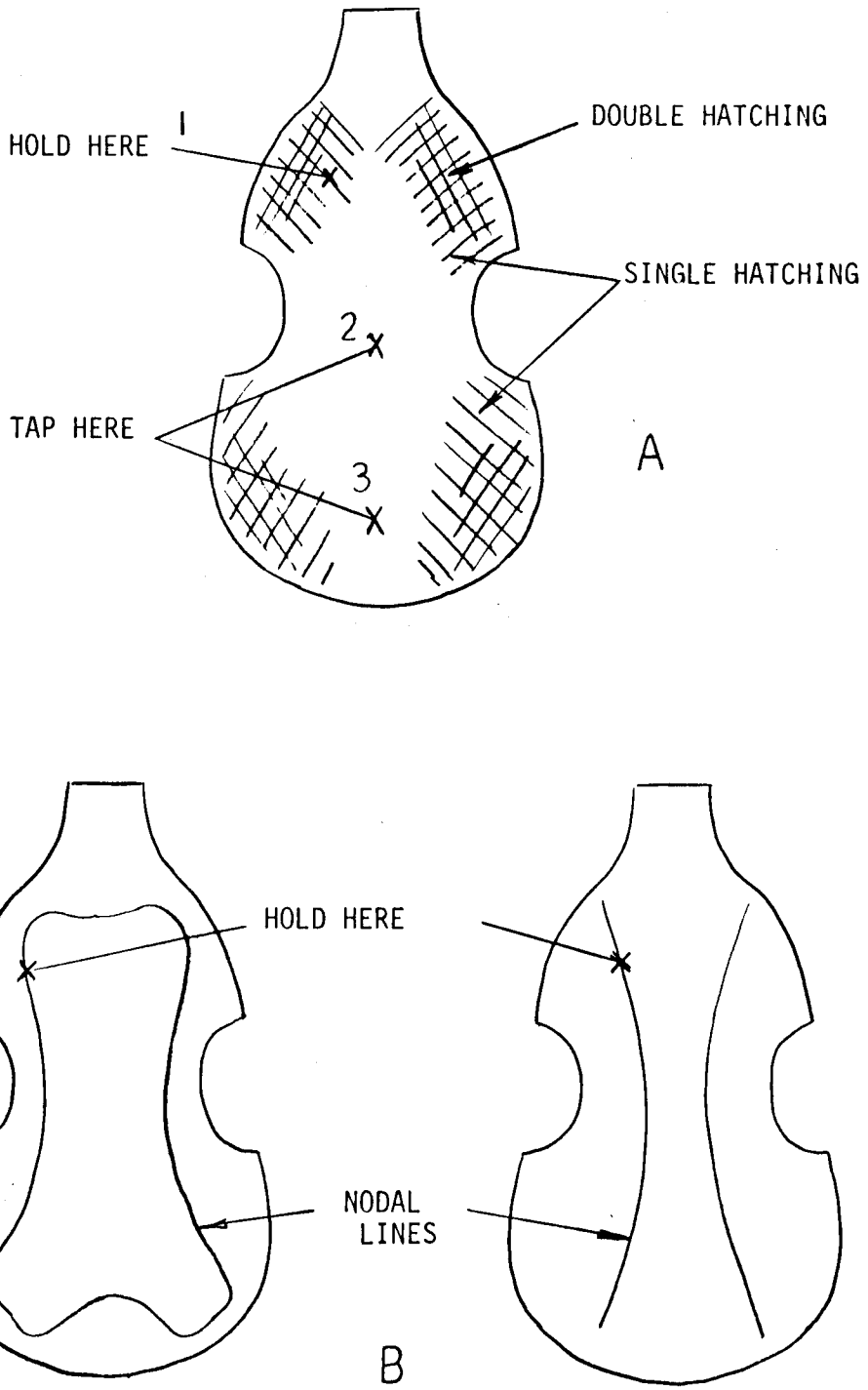


Figure 5-8. Belly Tuning

Tuning the Belly (Continued)

Make a record of the tone finally achieved, for use in tuning the bass bar.

An alternate tuning technique is to clamp the belly in a horizontal position, outside up, by the node shown in Figure 5-8B. The clamping point should be no larger in diameter than 1", and padded with thin sheet rubber. Sprinkle the back with some light, finely divided substance that can dance around on the wood (Christmas tree glitter works just fine). Take a well rosined bow and try it across the edge of the belly until you find a place where you get the most vibration (play it like a string). The glitter will move around on the belly and arrange itself in lines. These lines should look something like B in Figure 5-8. If not, scraping will move the nodal line away from the area being scraped. Make a "map" of the belly thicknesses for use when finish tuning the belly after it's glued on.

Cutting the Sound Holes

Trace, and cut out, a pattern for the C holes from Drawing No. 4. Include some of the edge and a corner on this pattern so that the holes may be properly located. Lay this pattern on the upper surface of the belly, and tape or hold it firmly in place. Using a very sharp pencil, trace the outline of the C hole on the top. Repeat for the other C hole. Drill a hole in each end of the outline big enough to pass the coping saw blade through. Mount the blade back in the saw frame and saw a slot the length of the hole. Don't get too close to the line, you only want to remove some of the material in the center. Keep the blade perpendicular to the surface. Finish cutting out the holes with sharp bladed knives (Xacto No. 11 blades are fine), and small files. Don't undercut or slant the edges, it doesn't look good.

CAUTION

When cutting with a knife, watch the wood grain. Always cut <u>across</u> the end grain, never <u>into</u> it. If you split one of those little corners off, it's an awful job to glue it back on right.

Cutting the Sound Holes (Continued)

NOTE

After the C holes have been cut, the belly will no longer give the proper tone; this will be corrected after the bass bar is fitted.

Fitting the Bass Bar

Cut a piece for the bass bar 1/2" wide, 5/16" thick, and 10-1/8" long. The lines, or reed, of the wood grain should be visible on the narrow (5/16") edge of this piece. This is so the grain is in the same direction as that of the belly. Mark the location of the bass bar, using Drawing No. 4 for reference. Remember that you're looking at the bottom of the belly and get in on the correct side. If you mistakenly glue it on the treble side, you can join the rather large club, composed of those of us who have done it wrong at least once! Mark one end of the bar "neck", and proceed to fit the bottom edge of the bar to the underside of the belly, in its proper location. When properly fitted, the bar should be perpendicular to the plane of the bottom edge.

The bar should be glued in place with a slight upward pressure in the center. This is accomplished by scraping the fitted surface of the bar at the ends until a little light can be seen under them. Coat the edge of the bar with glue, and clamp it down in place at the ends.

After the glue has set, shape the bar down almost to the outline shown.

Tuning the Bass Bar

After the bass bar blank has been glued in place, trim the bar roughly to the contour shown in Drawing No. 4. Hold the belly at the nodal point and check the tap tone; most likely all you'll hear is a dull clunk. While maintaining the proper contour of the bass bar, start shaving down the bar and testing the tone. When you start to get close to the tone found while tuning the belly, start rounding the edge of the bar as shown on the end view. Carefully continue shaping, rounding, and checking until you are

Tuning the Bass Bar (Continued)
back at the previously recorded belly tone. Again, it's a lot easier to scrape a little at a time, than to fit a new bass bar and start all over. (Unless you think you need practice in fitting bass bars).

Fitting the Locating Pegs

Lay the belly in place on the completed ribs, with the center join lined up with the center line of the rib and back assembly. Clamp it in place. Drill 1/16" holes through the belly into the end blocks, as shown in Drawing No. 4. These holes should be about 1/2" deep. Fit temporary pegs about an inch long, and not too snug (you'll be taking them in and out for now). Remove the clamps. The belly is not glued on until after the neck is fitted.

NECK AND FINGERBOARD

One thing to notice before cutting out this neck and fingerboard, is that the line dividing the contour of the upper portion of the "handle" from the lower portion is not at the junction of fingerboard and neck, as in a violin, but is about half way up on the fingerboard (see Figure 5-9). For this reason, no work should be done on the sides or cross section of the neck unless the fingerboard is temporarily glued in place.

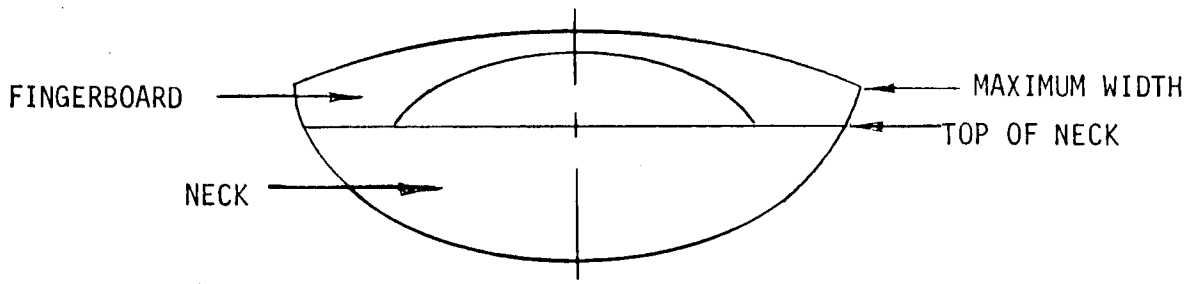


Figure 5-9. Neck and Fingerboard Joint

Roughing Out the Neck

First, you can save yourself a lot of grief in laying out the neck if you spend a little time preparing the wood block. Lay out a line perpendicular to the center of the log as shown in Figure 5-10(A). Plane one side parallel with this line (B). Plane the wide edge square with this surface (C). Plane the other side reasonably parallel with the first reference side (D), and to the thickness of the scroll at its widest point (usually the eye). Lay the side view plan of the neck on the last side planed in (D), hold it firmly in place, and draw the outline of the neck. The square upper surface may be used for the fingerboard surface of the neck. Include the pencil dots for the curl of the scroll. Saw the neck out, keeping just outside the outline all around. File the outside smooth to the outline all around. Establish a very good centerline all the way around the outline; top, bottom, end, scroll, everything. Strips of heavy celluloid with good straight edges can be bent around the curves to connect the center marks. Drill 1/4 inch holes all the way through at the locations of the peg holes.

NOTE

An accurate centerline is important, as the remainder of the work is referred to it.

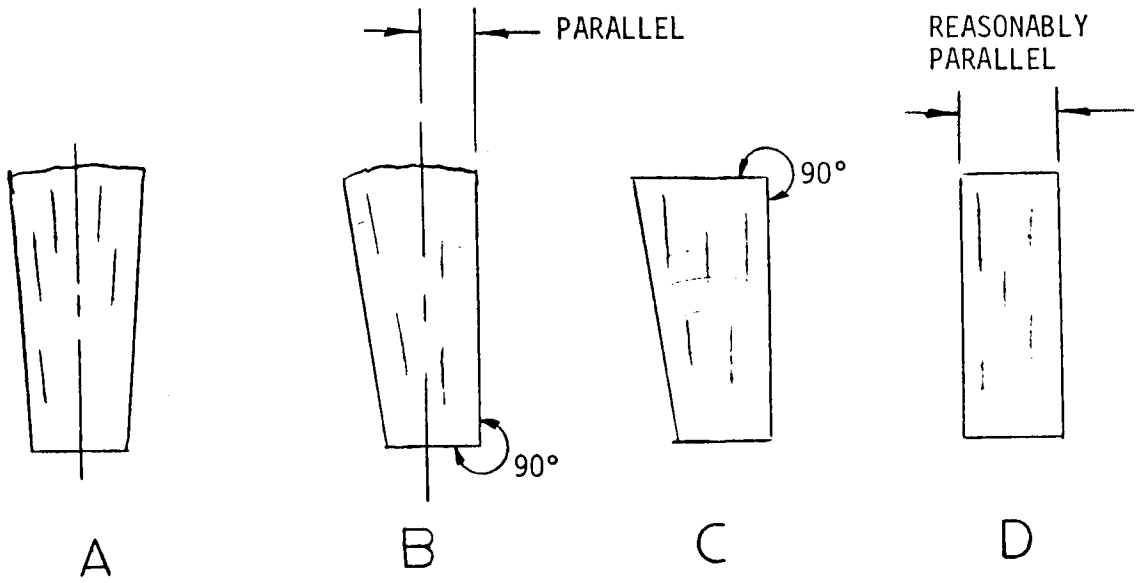


Figure 5-10. Neck Block Preparation

Roughing Out the Neck (Continued)

Lay the side view of the neck on the other side of the block, make the dots for the scroll. Connect the dots freehand on both sides. Working off the centerline, draw in the pattern for the peg box and the scroll pattern. The starting point for the scroll pattern is the heel, on the underside. Figure 5-11 shows the scroll pattern.

Rough out the peg box with drill and chisel. Note that the peg box tapers from top to bottom. The finished thickness at the bottom of the pegbox is 3/16 inch, and the bottom follows the back curve of the scroll. Saw out the cheeks of the scroll and finish them to the outside layout lines (see Figure 5-12, A-A).

Start cutting out the scroll on one side. As you do a section on one side, turn it over and do the equivalent section of the other. This balance will prevent you from damaging a greatly finished side by making heavy cuts on the other. Figure 5-12 shows the cuts and the order in which they are made. Make cut B-B down to the lines of the scroll pattern (Figure 5-11C), at each end of the cut. Undercut the piece along the line of the scroll pattern, and remove the piece. Make cut C-C, undercut; D-D, undercut; and so forth until you have come around to the front of the scroll and have no more scroll pattern line to guide you. Using a straight chisel for the sides of the scroll, and a shallow gouge for the helical surface, rough out the scroll to the guide lines; removing the corners and steps left from the sawing operation.

NOTE

Keep the sides of the scroll perpendicular to the side of the neck. Don't allow them to slant in at their bases - a common fault. The surfaces of the volute, or scroll, will be dished, but this may be done later.

It helps a lot to have a <u>real good</u> violin scroll to look at while you are doing this part.

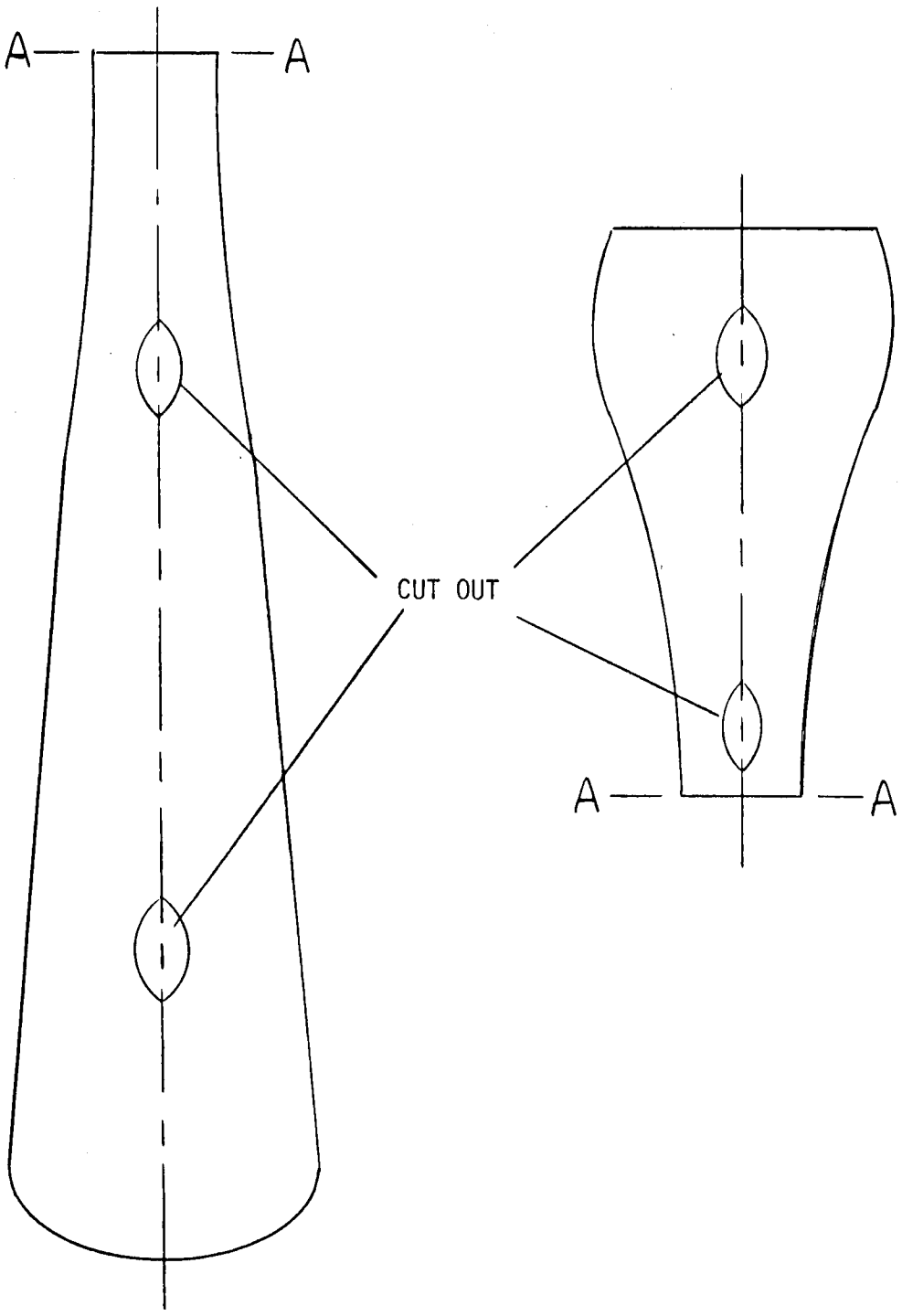
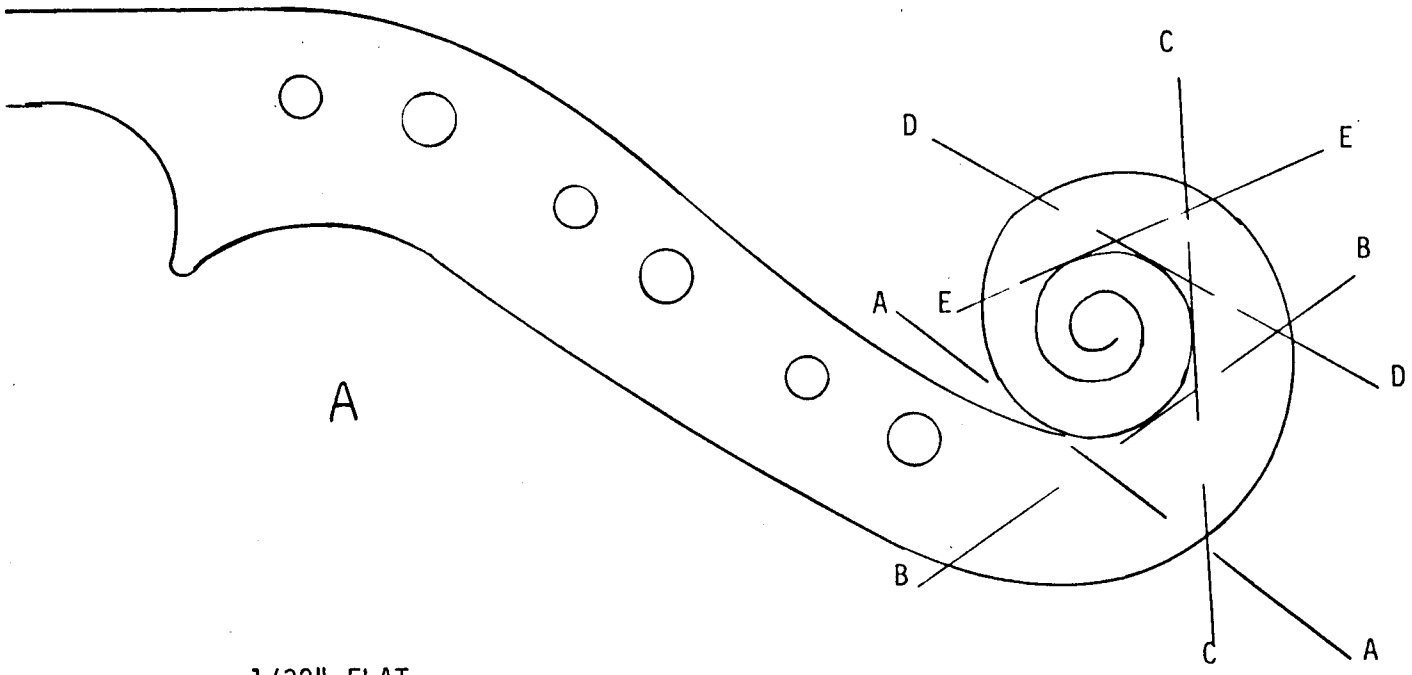
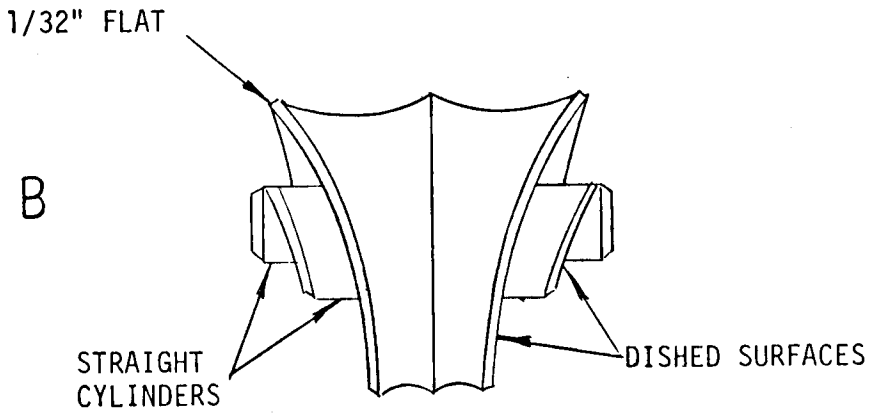
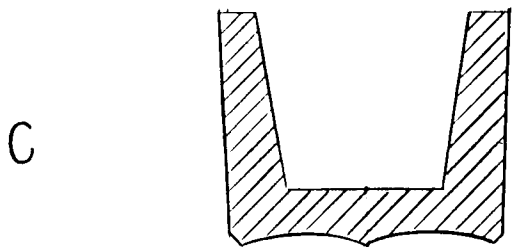


Figure 5-11. Scroll Pattern







CROSS SECTION OF PEGBOX

Figure 5-12. Shaping the Scroll

Roughing Out the Neck (Continued)

Making reference to Figure 5-12B and Drawing No. 4, continue the guide line for the scroll around the portion already shaped. Continue sawing and undercutting until almost to the eye of the scroll. Here you will probably have to finish with chisels and carving tools. Finish up the scroll with chisel, gouge, and scraper; dishing the surface of the volute in towards the center, leaving a 1/32 inch flat around the edge.

Using a gouge and round file, carve the twin grooves on either side of the center line around the outside of the scroll, as shown in Figure 5-12C. Again, leave a 1/32 inch flat around the scroll on the outside edge.

Saw out the blank for the fingerboard. Plane the underside flat. Mark a centerline on top, bottom and ends. Mark the limits of the recess in the bottom of the fingerboard. Using templates for reference, gouge out the recess in the under surface to finished size. The fingerboard can then be clamped between two thin pieces of plywood on the bench top, and shaped almost to final top contour (see Figure 5-13).

Glue the fingerboard temporarily in place on the upper surface of the neck with several small dabs of slightly thinned hide glue. Line up the two centerlines, and set the small end of the fingerboard on the line for the front face of the nut. Finish shaping the cross section of the neck and fingerboard, using the templates shown on Drawing No. 4. Do not shape the heel of the neck until after the neck is glued in place.

At this time, the peg box, scroll, fingerboard, and the handle portion of the neck may receive their final finish; scraping, sanding, and so forth. The last step in the finish of the scroll is to cut a 45 degree bevel all the way around the edges of the scroll, from the heel to the eye. This removes most of the 1/32 inch flat that was left on the two surfaces.

Fitting the Neck to the Body

Remove the fingerboard. Lay out the lines for the tenon on the neck. Using a back saw, cut the base of the tenon (Figure 5-14, cut A). Re-mark the center line. The neck sawing fixture (Figure 4-5, slot A) may be used. Saw the surface that mates

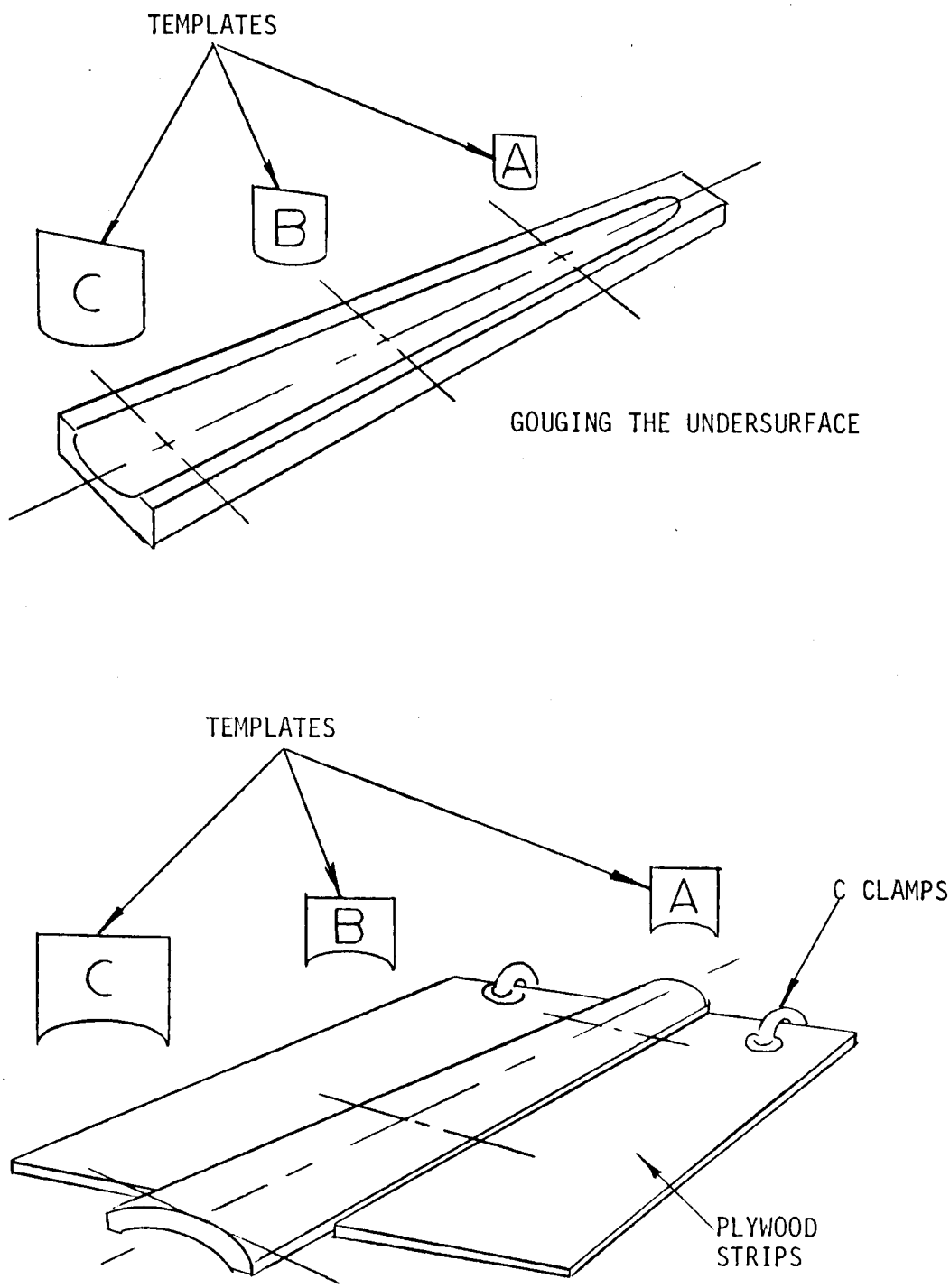


Figure 5-13. Preparing the Fingerboard

Fitting the Neck to the Body (Continued)

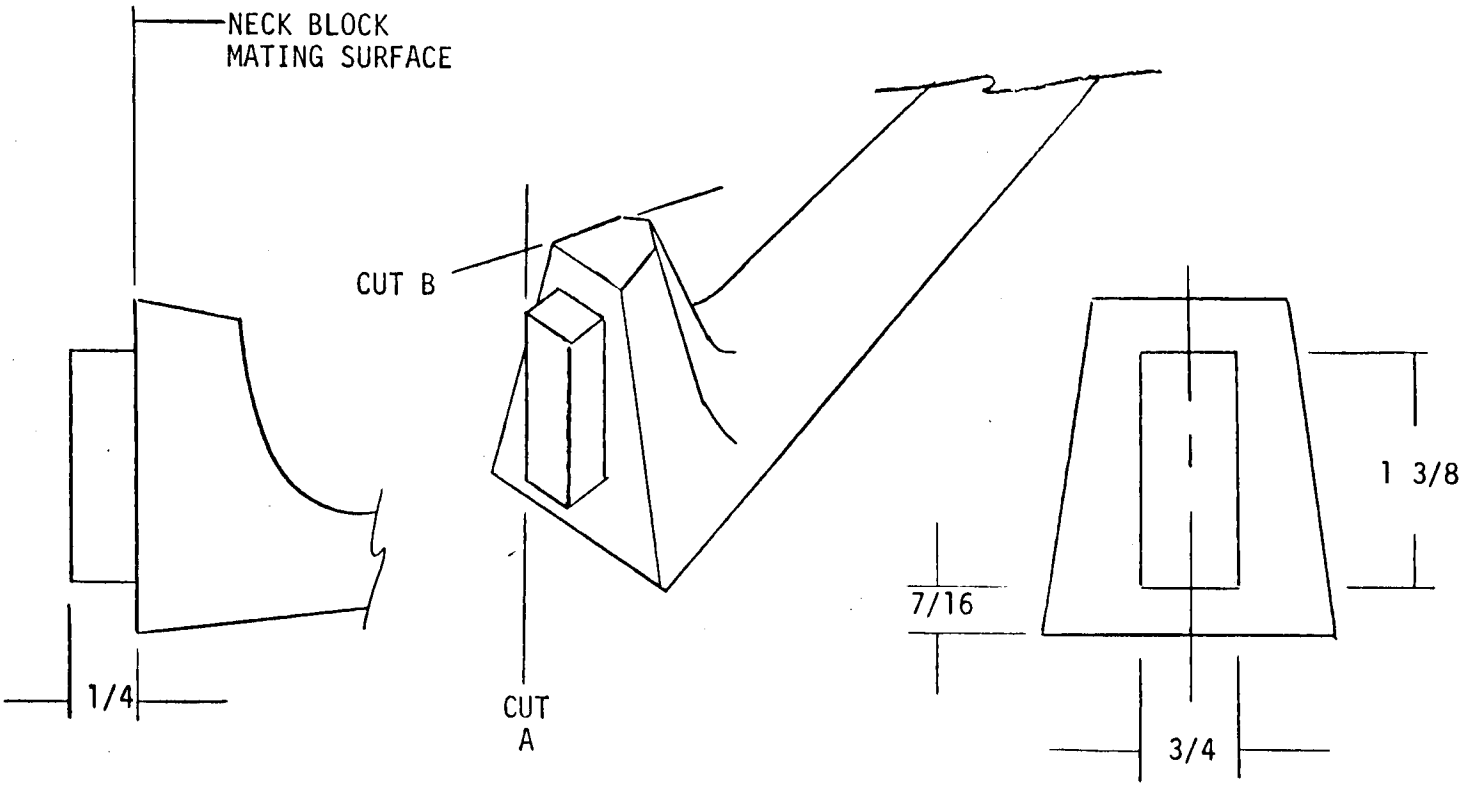


Figure 5-14. Neck Mortise and Tenon Joint

with the belly extension (Figure 5-14, cut B). The neck sawing fixture (Figure 4-5, slot B) may be used for this cut. Re-mark the center line and the tenon outline. Carefully saw out the remainder of the tenon, keeping the flat surface that mates with the neck block as one plane surface.

Lay out the mortise on the end face of the neck block. (Take the belly off the rib and back assembly while fitting the neck.) Carefully cut out the mortise, checking with the neck for fit, and with a straightedge for alignment on the body centerline. The sides of the tenon should be snug but not tight (to allow for the glue) when finally seated. The bottom of the tenon need not touch the bottom of the mortise. When fitted, there should be no gaps at the joint with the ribs; the top of the tenon should be flush with the top of the end block; and the belly extension should fit the bottom of the neck. Coat the tenon, end block, and belly extension with epoxy or full strength hide glue and clamp together using the setup shown in Figure 4-4.

Fitting the Neck to the Body (Continued)

At this point, with epoxy glue, you could consider the neck installation finished. However, it is considered traditional (some say necessary) to further reinforce the joint with nails. Square nails are usually used, in predrilled holes. I happen to have a goodly selection, salvaged from some very old buildings that burned. You can cut them out of steel or brass sheet, or square rod, then pound a head on them in a vise. A proper size for the treble could probably be made by shortening the cut nails used for oak flooring. These you can buy at a hardware store. Use two nails, one in parallel with the plane of the top, the other at a slight downward angle. Drill a hole the full length of the nail, no larger than the cross section of the nail just above its point.

CAUTION

Make sure that the nails and holes are shorter than the heel portion of the neck, when finished.

Ream the hole by twisting the nail, until it can be inserted by hand within 1/4 inch of its seated position. Back up the unfinished heel with a heavy sledge or the edge of a sturdy bench and drive the nails into place. (This business with the nails and glue is what we call in Vermont, a "suspenders and belt" job).

The heel of the neck may now be brought to its finished form. Use the illustration of the bottom of the back at the neck end on Drawing No. 4 as a guide in shaping the lower portion of the heel. The surface line of the ribs on the sides should proceed smoothly across the joint and heel portion of the neck.

GLUE ON THE BELLY

Prepare some pegs of spruce to fit the locating peg holes in the belly and end blocks. Make up some half strength hide glue (diluted with water). Go over the top edge of the ribs and blocks with sandpaper on a board to remove any glue lumps from the sizing operation. Get your clamps (Figure 4-3) set for size; and any other clamps ready to go. If you haven't already done so, glue in your label or write your name on the back, where it can be read through the C hole on the bass side.

Glue on the Belly (Continued)

Spread the thinned glue on the top edges and tops of the blocks, including the top of the neck tenon. Quickly lay the top in place, and align it with the pegs (the pegs should have a little glue on them). Clamp it securely, making sure that there is at least one clamp over each block.

When the glue has set, work the overhanging edge down flush with chisel or knife, taking care not to dig into the ribs. The edges of the belly and back can receive their final finish, sanding, etc., at this time.

PURFLING

The purpose of the purfling is to decorate the instrument. I have heard it said that it is also to reinforce the plates, but I've never seen it stop a crack from progressing across it. Since it is decoration, to be effective it must be well done. If you have never done any purfling before, I would suggest that you do some practice pieces. The purfling cutter must be handled firmly. The hard maple back resists the penetration of the blade; and on the soft spruce belly the blade tries to follow the softer lines. Don't try to cut the full depth of the lines with the purfling cutter; use it only to make well defined lines. Finish the cuts to depth with a knife. Don't try to cut all the way to corners and intersections with the purfling cutter; stop short and complete the cuts with the knife. Cut away from corners, you cannot hide overrun cuts short of removing that much wood. Hold the cutter firmly against the reference edge and start by making light sweeping cuts, increasing the depth gradually. Be ever alert to the cutter drifting away from the edge.

NOTE

Purfle the belly after temporary stringing up and final tuning.

Cut the lines to the width of the purfling, leaving some room for the glue. Cut them to a depth of not over 3/32 inch (you don't want to cut through the plate). Clear the wood out between the lines with the purfling chisel. Watch out here, also; even with the lines cut, the chisel will try to follow the grain of the wood.

Purfling (Continued)

The purfling should be bent to shape by wetting and heating it over the bending iron. If you are using laminated purfling (black-white-black) don't get it too wet or it will come unglued. Cut a strip approximately to length, wet it, and bend it; trying it over the groove for fit. After it's bent, lay it aside to cool with a weight over it, to keep it bent. Bend the center bouts first, as they are the hardest.

When the purfling is all bent, commence to fit it in the grooves. The corners and intersections are mitered, with each piece cut to half the intersecting angle (see Figure 5-15). Fit the center bouts first. The bottom purfling can be in one continuous piece, corner to corner; or can be fitted in two pieces with the joint at bottom center. Leave the pieces in the groove as they are fitted.

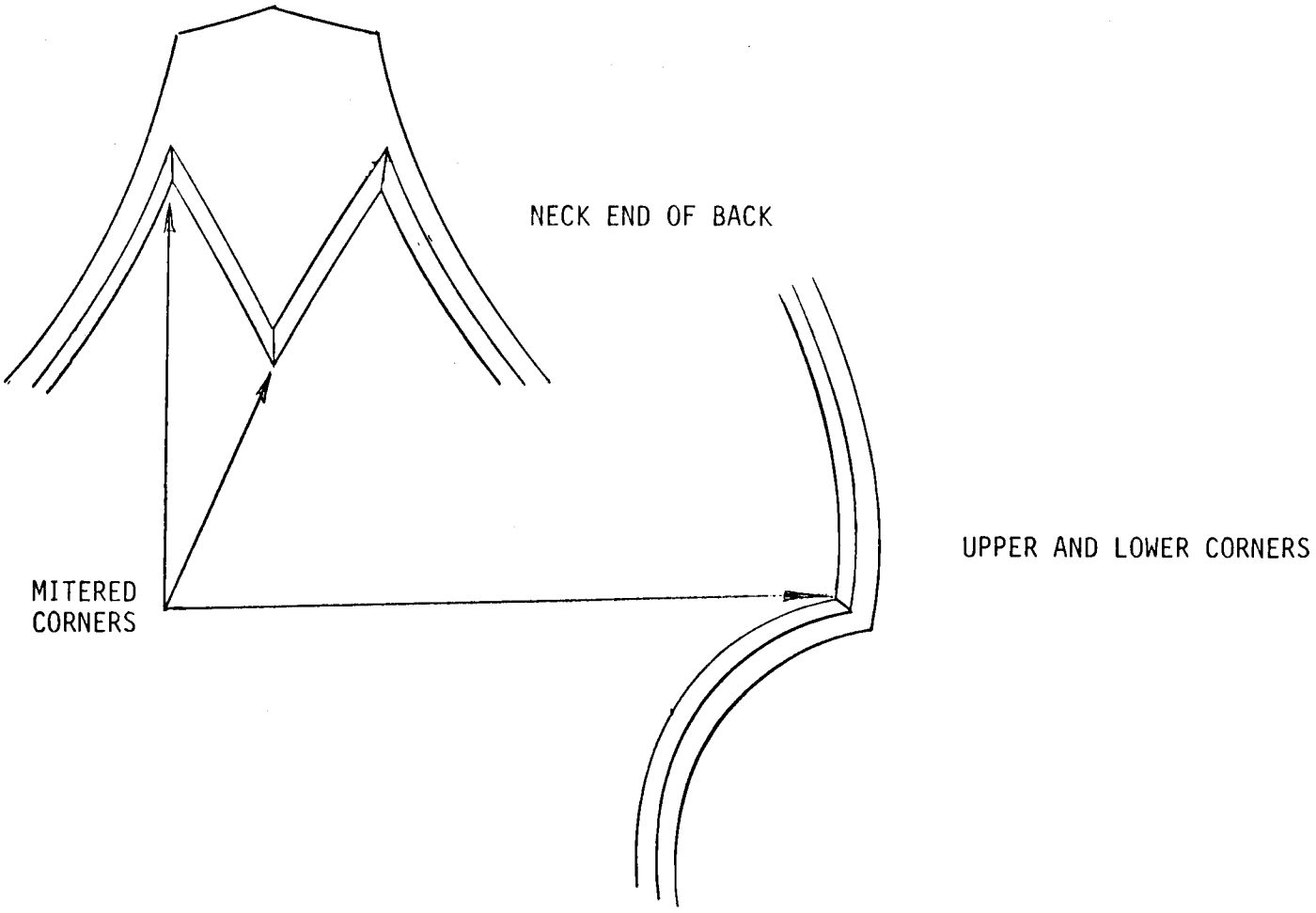


Figure 5-15. Mitering the Purfling

Purfling (Continued)

Gluing is accomplished by lifting out one piece at a time and gluing it in before doing the next. Start with the center bouts. Run a little glue into the groove, trying not to get too much near the corner, or intersections, with the next piece. Press the purfling into the groove starting at the corner. After it is completely inserted, press or rub it firmly into place with a hard, smoothly rounded stick or tool handle. If any excess glue squeezes out into the next section, clean it out immediately.

After all the sections are in place, and the glue has set, level off the protruding edges of the purfling. A very shallow gouge can be used, followed by scraping or sanding.

TAILPIECE

Saw out the blank for the tailpiece (see Drawing No. 4). Plane the underside flat. Mark a centerline on top, bottom, and ends. Mark the limits of the recess in the bottom of the tailpiece. Refer to the techniques shown in Figure 5-13 for the fingerboard. Using templates for reference, gouge out the recess in the under surface to finished size. Turn the tailpiece over and shape the top surface to final contour, using templates for reference. Lay out the hole for the hook-bar. Drill a hole within the lines and file the hole out to size.

NOTE

Notice that the hole for the hook-bar goes through the tailpiece at an angle to the bottom surface. This is the angle that the tailpiece assumes when the instrument is strung up.

Locate and drill the holes for the strings. Slightly chamfer the sharp edges of the holes, top and bottom.

CONSTRUCTION

HOOK-BAR

Cut out the piece for the hook-bar (see Drawing No. 4). Finish it all over. Hold it in place on the tail end of the ribs, and carefully scribe around it. Lay out the depth of the recess on the edge of the belly. You can start the cut for the recess by tilting the back saw back towards the belly. Cut and chisel the recess for a reasonably tight fit with the hook-bar. The undersurface of the hook-bar should fit the bottom of the recess for maximum gluing area. Remember, the hook-bar takes all the string pull, and all that holds it in is glue. Using epoxy or full strength hide glue, press the hook-bar firmly into place, and don't disturb until the glue is well set.

NUT

The nut is cut from ebony, to the dimensions shown on Drawing No. 4. Leave it a little high for fitting. Lay out the string notches, and lightly cut them out. Using very little of a thinned glue, fix the nut in its proper place on top of the neck. Temporarily glue the fingerboard in place. Cut the top of the nut down to 3/32 inch higher than the surface of the fingerboard. Cut the string notches down as you go, but keep them shallow. The nut and notches will be finished during preliminary stringing up.

PEG FITTING

Mark the pegs as to which hole they will go into. They do vary slightly in size and taper. Using a violin peg hole reamer, or a Brown and Sharpe (B&S) taper pin finish reamer No. 2, ream the holes to fit the pegs. The shanks of the pegs should extend about 3/8 inch from the cheeks of the peg box. Cut the other end off nearly flush with the opposite cheek, and bevel or round off the cut end, slightly. Mark a string hole location that will allow the wound string a straight (or nearly so) run from the peg to the groove in the nut. Remove the pegs, drill the holes, and lightly chamfer the entry and exit of the holes.

Peg Fitting (Continued)

NOTE

You should have the strings that you will be using by this time. Measure the peg end of each string, and size the holes so that they don't exceed the string diameter by much more than 15%. This precludes problems with strings slipping out when they are brought to pitch.

The pegs may be lubricated with commercial peg dope, or by the old standby of dry soap and chalk (more soap = peg moves easier, more chalk = peg holds harder). Final adjustment of tightness will probably have to be done when the strings are put on.

BRIDGE

The bridge is made from quartered maple, with the thick side of the wedge at the feet. The figure is the so-called "spotted". That is, when plain maple is quartered, the little dots and dashes that are the medullary rays show up across the wood. Taper the wood to approximately the right thickness top and bottom first, as it is difficult to hold onto after cutting to shape. Trace the pattern on the wood as on Drawing No. 4, to the full outline (unfitted).

Drill holes in the blind center hole, rough it out with a coping or fret saw, finish with small files or sanding sticks. Saw the outline and finish the same way. Mark one side with your initial so you can keep that side always nearest the tailpiece. This side stays flat. Locate the bridge position on the belly, and shape the bridge feet to fit the belly with the marked face of the bridge vertical. Lay a straight edge on the top of the fingerboard and slide it up to the bridge location. Stand the bridge up to the straightedge. Make a mark on the treble side of the bridge 5/16 inch up from the extended fingerboard line. Mark the bass side of the bridge 3/8 inch up from the extended fingerboard line. Connect these two marks with an arc, the same radius as the bridge end of the fingerboard. Cut the bridge off on this line. Mark the string locations and make very shallow notches at these locations. The top of the bridge will be finish fitted during stringing up.

FITTING THE SOUND POST

Cut the sound post from a straight grained piece of spruce. Round it down until it is 1/4 inch diameter. Trim one end square. Stick the sound post straight down through the C hole on the treble side, with the square end against the back brace. Sight across the belly and estimate where the inside surface of the belly is, at the sound post location (see Drawing No. 4). Cut the post off at this height, with the end at the angle of the belly under surface at the sound post location.

NOTE

The grain, or reed, on the end of the sound post should be at right angles to that of the belly.

With the setting tool, insert the sound post in through the treble C hole, and bring it up into place, in the position shown in Drawing No. 4. The post should be in a vertical position, relative to the back. If it can't be brought up vertical, it's too long and can be shaved off a little at a time until it fits.

CAUTION

Do not force the sound post into place. This is the cause of many cracked bellies. It should just fit hard enough to keep it from falling down during normal handling of the instrument (before stringing).

The location of the sound post is critical to the musical response and balance of the instrument. The position given is an average, or arbitrary, starting point, and may need to be changed during final tuning and regulation.

PRELIMINARY TESTING

Before varnishing the viol, it will be fitted temporarily with frets, strings, the bridge and nut adjusted, then played to test the tone and balance of the instrument.

Installing the Frets

The frets are fitted at the positions given in Figure 5-16. Measure down from the nut, and make a pencil mark at each location. Start tying the frets with the one farthest from the nut. Tie each fret about 2 inches closer to the nut than its final positon, then slide it down into place. Some typical fret knots are shown in Figure 5-16. Position the knots on the back of the neck under the sixth string.

Stringing Up

Fasten the strings to the tailpiece, using the knots shown in Figure 5-17. Knot A is used for the finer strings, and knots B and C can be used for the heavier strings. Do not let the knot bear against the hole. The knot should bear against the bridge end of the tailpiece. Slip the tailpiece on the hook-bar. Start the third string in its peg, and wind it on smoothly. When it's almost tight, stand the bridge under it with the string in its notch, and lightly tension the string. Repeat with the fourth, fifth, second, first, then sixth strings.

NOTE

Stringing up in this order prevents the tailpiece from cocking over to one side and putting a strain on the hook-bar.

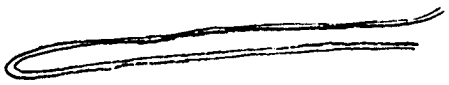
The strings should clear the first fret by 1/32 inch under the first string, and by 3/64 inch under the sixth string. The remainder of the strings should be on a line, the radius of which is the radius of the fingerboard at the nut. Deepen the notches in the nut to achieve this clearance, or remove the strings and cut down the nut, then renotch. In no case should the strings be imbedded more than half their diameter in the top of the nut. If so, cut down the nut.

At the bridge end of the fingerboard, the first string should stand 5/32 inch above the fingerboard; and the sixth string 1/3 inch above the fingerboard. The other strings should fall on a line which is the radius of the fingerboard at the bridge end. Cut down the bridge on this radius, and imbed the strings no more than half their diameter in the top edge of the bridge.

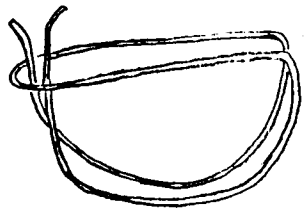
Vibrating string length = 14" (nut to bridge)

Distance from nut to:

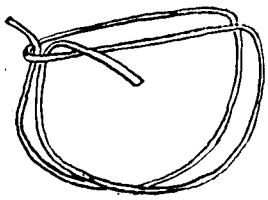
1st Fret = 1-49/64"
2nd Fret = 1-33/64"
3rd Fret = 2-15/64"
4th Fret = 2-29/32"
5th Fret = 3-17/32"
6th Fret = 4-1/8"
7th Fret = 4-43/64"



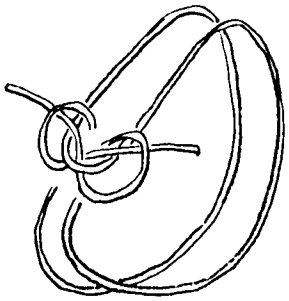
double loop - - -



around the neck and up through - - -



around the same side - - -



- - - under the end of the loop, over the opposite side, under the opposite end where it comes up through the loop.

Pull tight - - - finish off ends with a square knot.

Figure 5-16. Frets and Fret Knots

Stringing Up (Continued)

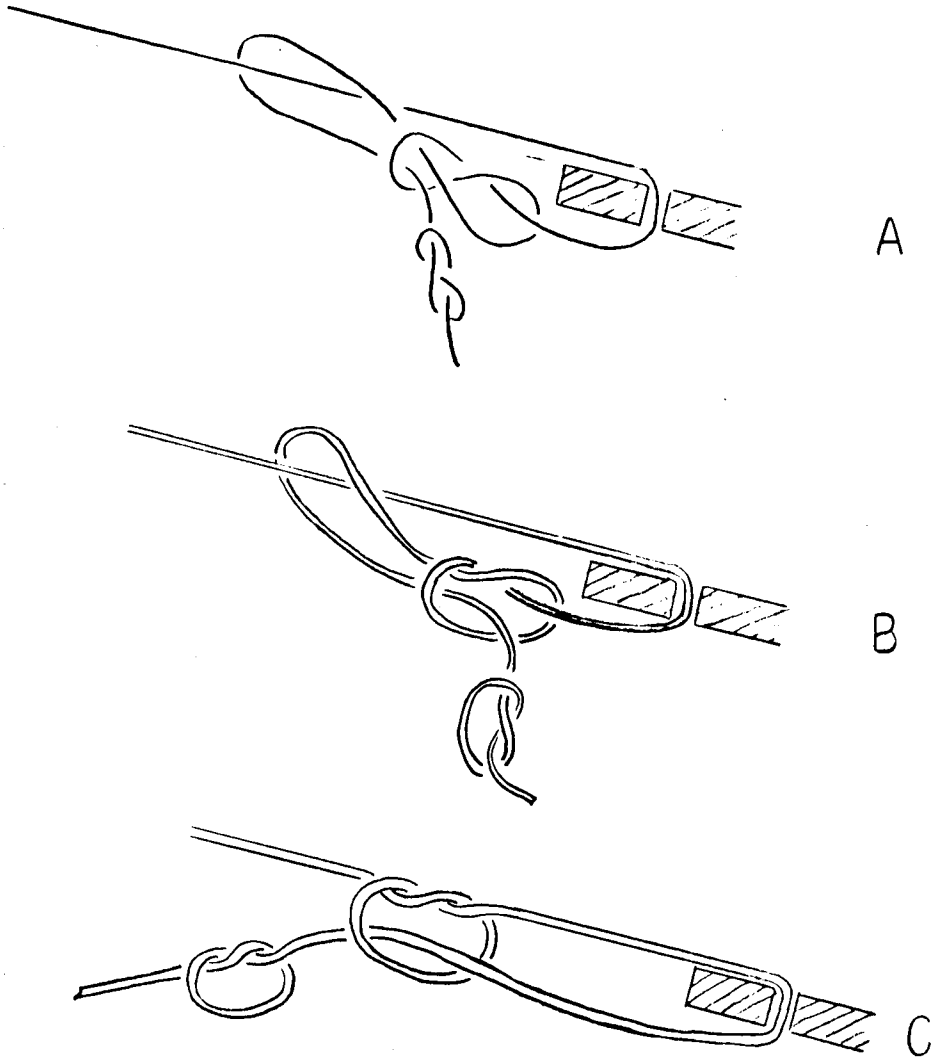


Figure 5-17. Knots for Strings

Remove the bridge and taper the back face up from the feet to the top edge, making the top edge 5/64 inch wide all the way across. Round the top edge slightly. Rub a little pencil lead in each notch in the bridge to keep the strings from hanging up during tightening. Do the notches in the nut, also.

Stringing Up (Continued)

Stand the bridge in place, with the strings in the notches of bridge and nut. Start to bring the strings up to pitch a little at a time. Keep the flat face of the bridge vertical, the strings tend to pull it over toward the fingerboard. You will have to keep bringing them up to pitch for a while, as they do stretch, and the wood parts take an initial set.

CAUTION

If the strings never seem to come up to pitch, or drop out of tune quickly, STOP, and start looking closely at joints, knots, hook-bar - everything. Something may be giving, and if you catch it before failure, you can save some damage.

Final Tuning the Belly

Now you can play the viol and hear the first results of your labors. Play it a lot yourself, and let others play it while you sit back and listen. What you are listening for is good tone, a clear response, and a balance in the power of the strings. It helps a lot on your first viol if (as in my case) you can talk an experienced player into critiquing the instrument for you. Don't expect it to sound like the violin family; it doesn't. If the tone is good in all respects, and the response even through its entire range, then the instrument is ready for belly purfling and varnish finish.

NOTE

The viol will sound different before varnishing and after, but the point is, if it doesn't sound musical in the white, it won't sound good after finishing.

Final Tuning the Belly (Continued)

If the tone is muffled or harsh, first try moving the sound post a little further down the belly from the foot of the bridge. Since the belly slants, make sure the post isn't too long so that the belly is damaged.

CAUTION

Before removing the sound post, loosen the string tension.

If no real improvement is noted, return it to its original position, as shown on Drawing No. 4, and proceed to tune the belly.

Tuning the belly consists of improving the "voice" of the viol by reducing the stiffness of the belly, while still retaining sufficient strength and elasticity. The outer surface of the belly is scraped to thin it, while still endeavoring to preserve the arching. The thinning will be most effective if it is done near the outer boundaries of the belly, where the graduations are already the smallest (reference Drawing No. 3). These areas are shown in Figure 5-8 by double hatching. If after this scraping the tone is still sort of dry and harsh, and the bass notes muffled or weak, thin further into the four sections of the belly shown by the single hatching on Figure 5-8. Avoid developing hollows, and keep blending the area scraped into the existing arching.

Try and avoid thinning the belly to less than 2 mm (5/64") at any point. If you made a record of thicknesses on the drawing when the belly was scooped, this will be a great help here. If you get the belly too thin, it may be loud, but become unstable; and "wolf notes" will result at some point in its range. Especially avoid getting the upper bouts too thin. Keep the strip down the center of the belly the full thickness to resist the pull of the strings. Don't go to the absolute minimum thickness before trying the next step.

Final Tuning the Belly (Continued)

When you have approached the limits of the thinning, and if the tone is still lacking in fullness and depth (especially the lower notes), you may remove the belly (remember the thin glue?) and reduce the size of the bass bar.

NOTE

To remove the belly, start a sharp knife into the joint between belly and rib; as soon as you've made a start, use a dull, thin bladed table knife to finish.

Plane 1/16 inch off the top of the bar at the center, then re-taper from the high point to the ends. Round the top edge as before. Replace the belly and restring. The bass should now have improved. A change in the position of the sound post may be necessary. If necessary, finish by more scraping of the belly.

FINISH

Before finishing, unstring the instrument, and remove fingerboard, nut, tailpiece, and pegs. A dummy fingerboard may be lightly glued on the neck to prevent damage to the edges, and from varnish lapovers. The belly should be purfled at this time. Do not sand the instrument until after filling.

I'll make a comment here on varnish colors. You may have a favorite color for instruments, such as a darker yellow, orange, red, or brown. It's all right to use whatever of the traditional colors you want, you can find old viols in each. But as a matter of fact, these old instruments were probably originally finished in fairly light natural colors. A lot of the darker shades that we see today are the result of 200 years worth of aging and oxidizing of the finish. If you have nice wood, and good workmanship, why hide it beneath layers of color? A little foundation stain, plus the natural slight amber or gold tone of oil varnish (while initially somewhat bland in appearance) will in time result in some really fine colors as the wood matures. After all, don't we all have a little conceit in thinking that we are <u>really</u> building for generations hence? (If not 20th century Stradivarii, at least a Barak Norman!).

Cleaning

During the handling of the viol in the white it has probably gotten dirty. It can be cleaned with naptha or lacquer thinner on a cloth.

CAUTION

These solvents are both very flammable and not too pleasant to breathe. Use in a well ventilated area, and away from any sources of ignition.

After cleaning, let the instrument hang for a while in a well ventilated area to dry.

Foundation Stain

Foundation stain is a yellow water-base stain, available from violin supply houses. It is applied to the bare, unfilled wood. Two coats are usually applied. It will raise the grain, but do not sand after application. Let dry 24 hours before filling.

Filler

For filler use fresh, 3-pound cut white shellac, diluted one to one with denatured alcohol. Let each coat dry about 12 hours, sand lightly with 400A silicon carbide paper, dust off, and apply the next coat. If care is used in covering the entire viol, and no brush strokes remain, two coats should be sufficient.

Varnish

At least four coats of oil base violin varnish should be applied. This should give an even, continuous finish, with a uniform color. If you have facilities for spraying on the varnish, this results in a much superior finish.

Varnish (Continued)

NOTE

Try to do the varnishing and drying in a clean, dust free space. You can nearly remove your latest coat of varnish while sanding out little dust fuzzies, airborne sawdust, and cat hair. If you don't have a good place, it's worth while making up a clean cardboard box with a lint-free curtain on the front in which to hang the viol.

Sand down after each coat is dry with 400A silicon carbide paper. Depending on the heat and humidity it may take up to a week for the varnish to dry (especially the final coats). Dust off the viol and blow out the inside before each coat of varnish is applied.

I would recommend that the last coat or two coats be clear varnish if you have used a colored varnish. Sand the last coat down smooth with the 400A paper, dipped in water, until the finish is smooth. Next, sand with 600A silicon carbide paper dipped in water, until the finish is dull, blemish and scratch free. This sanding will soften the finish so set it aside to harden for a week or so.

Polishing

Take a rag or piece of felt and wet it with water. Sprinkle it with pumice, and rub the finish - with the grain. Wipe off the pumice and water often and check your progress. You are looking for a dull, satin smooth finish. Do the final finish with a fresh cloth or felt, wetted, and sprinkled with rottenstone; also with the grain. Again, this polishing will soften the finish somewhat, so let it harden for a week before final assembly.

Alternative Finishing Materials

When I built my first violin, and before I had located sources of supply for finishing materials, I used all sorts of common materials that were available locally.

Alternative Finishing Materials (Continued)
For what they're worth, I'll list them here.

Varnish - Masury Cosmo-Spar Varnish.

Foundation Stain - Grumbacher Yellow Ochre Water Color in water.

Polish - I started with the coarsest auto body compound and worked my way to the fine. Final polish was with silver polish - which is really a suspension of jeweler's rouge.

Varnish colors - Just any old oil color can get you into trouble. Most of them are not transparent, and will hide the grain. You must use very little, and of the transparent colors only, and arrive at the shade wanted by several light coats. The only truly transparent artists colors are Rose Madder (red) and Viridian (yellow).

Imitation Ebony - Two coats of Pratt & Lambert Tonetic Ebony stain rubbed down well on straight grained, very smooth maple will look just like ebony. This doesn't sink in very far, so it has to be done last, after all shaping and sanding. This stain is also good for staining out any brown streaks in genuine ebony.

FINAL ASSEMBLY

After the finish has hardened, reassemble the viol for the final time. Glue the fingerboard and nut on as you did before, but use a full coat of full strength glue this time. Let dry, and tie on the final set of frets, getting them as tight as you can. String up the instrument and recheck the string height above the first fret and the end of the fingerboard. Set the bridge in its proper place, mark lightly around the feet, remove the bridge and lightly scrape away most of the varnish that will be under the feet. A little finely powdered bow rosin can be lightly dusted on these spots; then the bridge replaced, and the strings brought up to pitch. Removing the varnish and dusting with rosin will keep the bridge feet from slipping.

6. CORRECTING FAULTS

GENERAL

Detailed instructions for doing the basic tuning and balance of the instrument are found in Chapter 5. If it becomes necessary to go into tuning of the belly on an instrument that has been completely finished, it's better to take off the belly and scrape the inside, than to try and match the finish on the outside.

SOUND POST EFFECT

If the response is even on all strings, but rough, and harsh sounding, try moving the post back towards the bridge. If the high strings are weak and the low strings harsh, move the post outwards towards the C hole. If the low notes are weak and the high ones shrill, move it towards the center. Moving it straight down away from the bridge improves the volume on the low notes.

NOTE

All of the above are only suggestions, and by no means sure fire on every instrument. Move the post a little at a time, and play it a lot each time.

ONE STRING TOO LOUD

Try installing one of the little donut shaped plastic rings that are supplied with some brands of violin strings under the string at the bridge. These can also be cut from heavy wall plastic tubing, or the heavy plastic insulation found on some wires can be cut in short sections and stripped off. Another brand of string can be tried also.

ONE STRING TOO WEAK

I've never had this problem, only the opposite. (That is, on a set of new strings.) I imagine you would have to try another string, or another brand. On old strings, one will weaken before the rest; then's the time to put a whole new set on, as the rest will soon go.

BUZZING NOISE

Invariably this is some little thing vibrating. It can be two strings barely touching in the peg box. (If they are bearing heavily, they won't buzz.) The notches in the nut, if too deep, will cause a buzz. If the angle of the back (peg box) side of the nut is the same as the exit angle of the strings, they will buzz. A string may be hitting a fret further towards the bridge. If you can narrow the buzz down to one string, bow it firmly and move up one fret at a time. When the buzz disappears, that was the fret that it was hitting. You'll have to check that fret for height; shave it a little under that string only with a razor blade, or try shimming the string up at the bridge with a tiny piece of wood in the notch. The problem of hitting a fret is worst with the bass strings, which really move around when bowed.

POOR OVERALL TONE

Even the most carefully made viols don't do their best with low-grade strings; and, not surprisingly, even the worst instrument sounds better with top notch strings. I'm always short of money when I build an instrument, and I used to economize on strings. By now, I've had enough object lessons to prove that, if I've spent all that time and effort building a good instrument, I'll never know it 'till I put good strings on it.

7. ORNAMENTATION

PURFLING, PLAIN AND FANCY

The simplest kind of purfling to be found on a viola da gamba is none at all. Sometimes, if the instrument had a particularly beautiful back, the back was left plain. From this we go to one line black, two line black, black-white-black, dots and diamonds, and so forth. The gambas were made back in the days when imagination ran rampant (and wealthy patrons were still to be found).

Double line purfling (two black lines) is easily done, with the outer line at the normal edge spacing, and the second line 1/8 to 3/16 inch inside of the outside line.

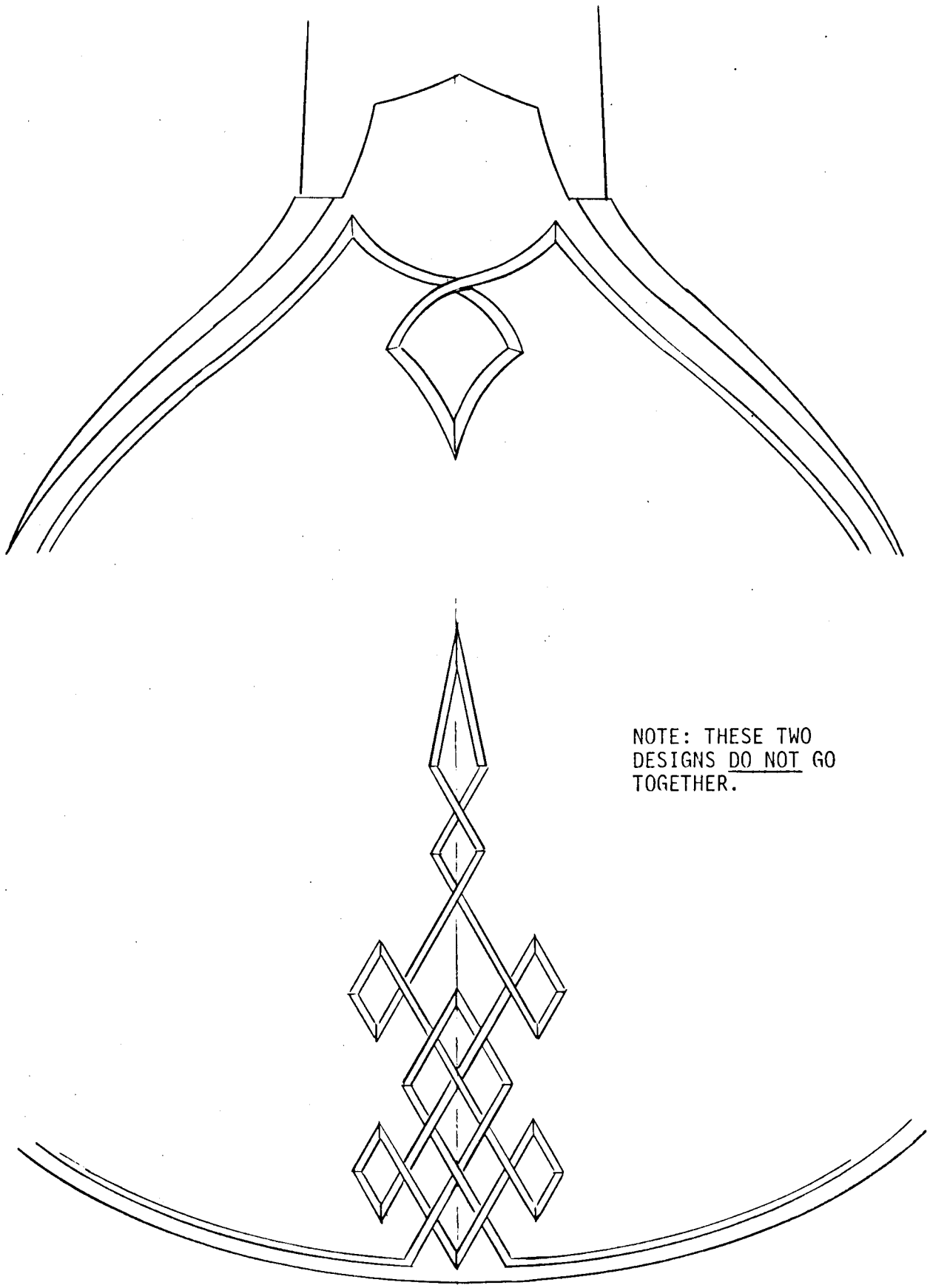
Several suggestions for fancy purfling designs at the top and bottom of the back are given in Figure 7-1. It is also very effective (especially if the wood is rather plain) to purfle a single black line border on each section of the ribs; at about the same edge spacing as the belly and back. (See Figure 7-2.)

PAINT

It was the custom with Stradivarius, and others, to outline the bevelled edges of the scroll with flat black paint. The edges of the sound holes were also painted black, as were the corners of the center bouts. As a matter of appearance, the bass bar is sometimes painted flat black in the middle if it shows through the sound holes.

INLAYS

The tops of the fingerboard and tailpiece were often inlaid with geometric patterns in a contrasting material. The edges of fingerboard and tailpiece were sometimes made of an ivory strip. Sloane[9] has an interesting method of making complicated inlays by creating a sort of mosaic on vellum, then gluing this on top of the fingerboard or tailpiece. I have a plan of a Division viol by Henry Jaye of London that has an inlaid and carved rosette on the belly, just under the end of the fingerboard.



NOTE: THESE TWO DESIGNS DO NOT GO TOGETHER.

Figure 7-1. Purfling Designs for Back

Inlays (Continued)

One source of ivory is old piano key tops. Whenever someone junks a piano, I strip it of keys for the ivory and ebony, tuning pins and strings for dulcimers and psalteries, the sounding board for the quarter sawn spruce, and even the veneer. Some key tops are not ivory, but celluloid instead. Try one with a match; ivory stinks like burning bone or hair, celluloid melts and burns. Some of the black keys are also dyed walnut, instead of ebony.

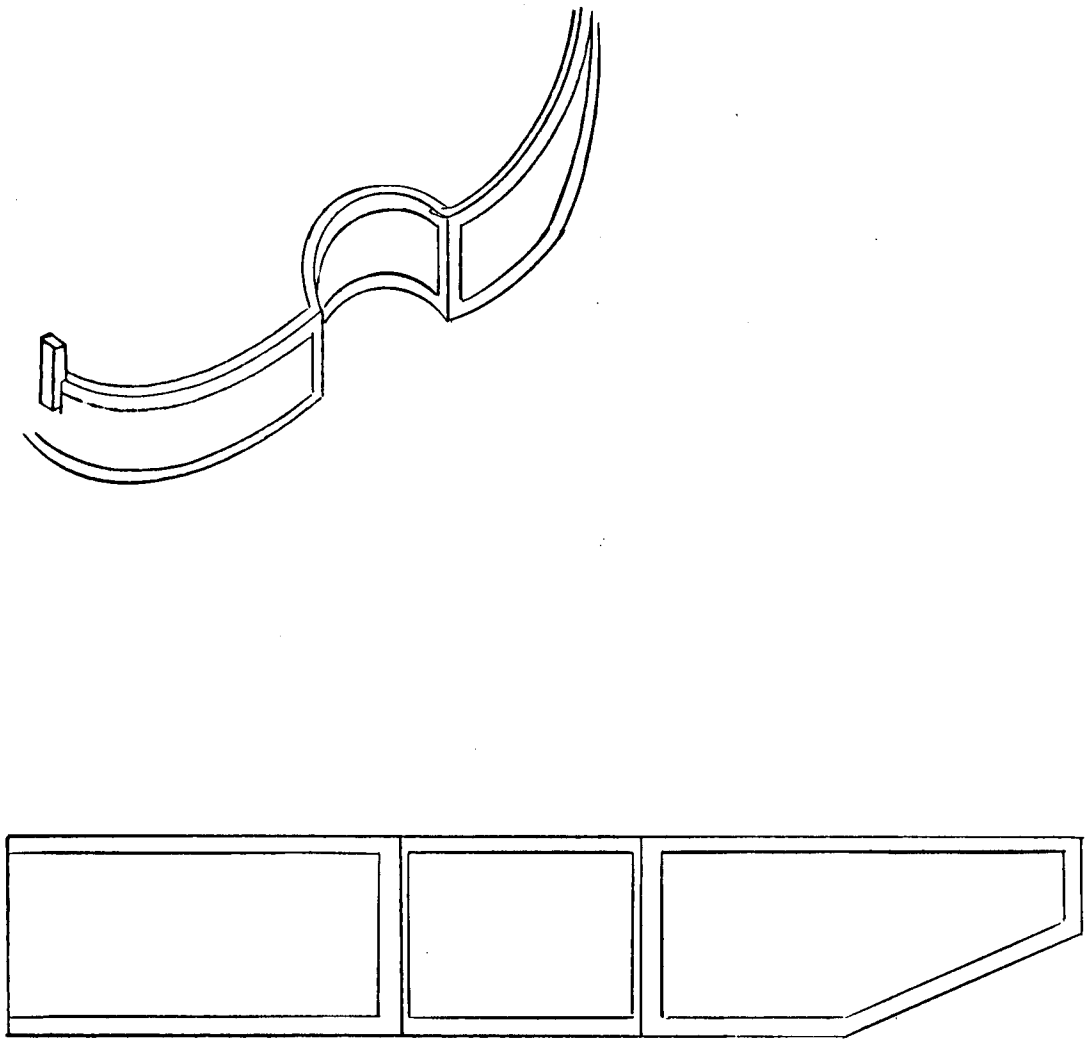


Figure 7-2. Rib Purfling

ORNAMENTATION

CARVED SCROLLS, HEAD, FIGURES

As I mentioned in the second chapter, the viols were often found with other than a plain scroll at the end of the peg box. Figures 7-3 and 7-4 illustrate two versions of more elaborate scrolls. Some interesting design ideas for preparing your own version can be found in the "Handbook of Ornament"[11]. There are many illustrations of animal and human heads in this book, and if you have some artistic talent, these can be adapted.

FINGERBOARD AND TAILPIECE ENDS

The end of the fingerboard and tailpiece closest to the bridge was sometimes ornamented by cutting it into a pattern. Some examples of this are shown in Figure 7-5.

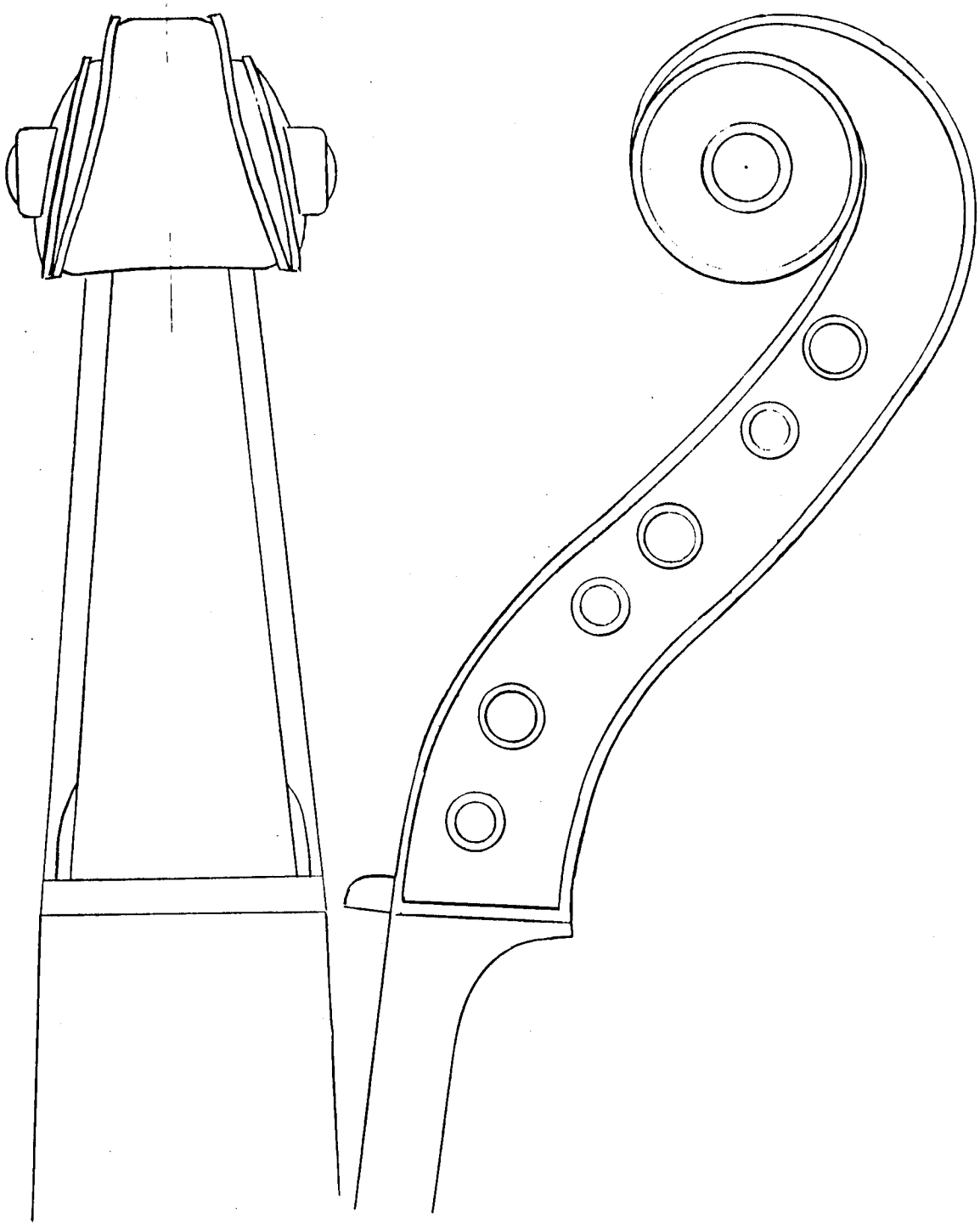


Figure 7-3. Rosette Scroll

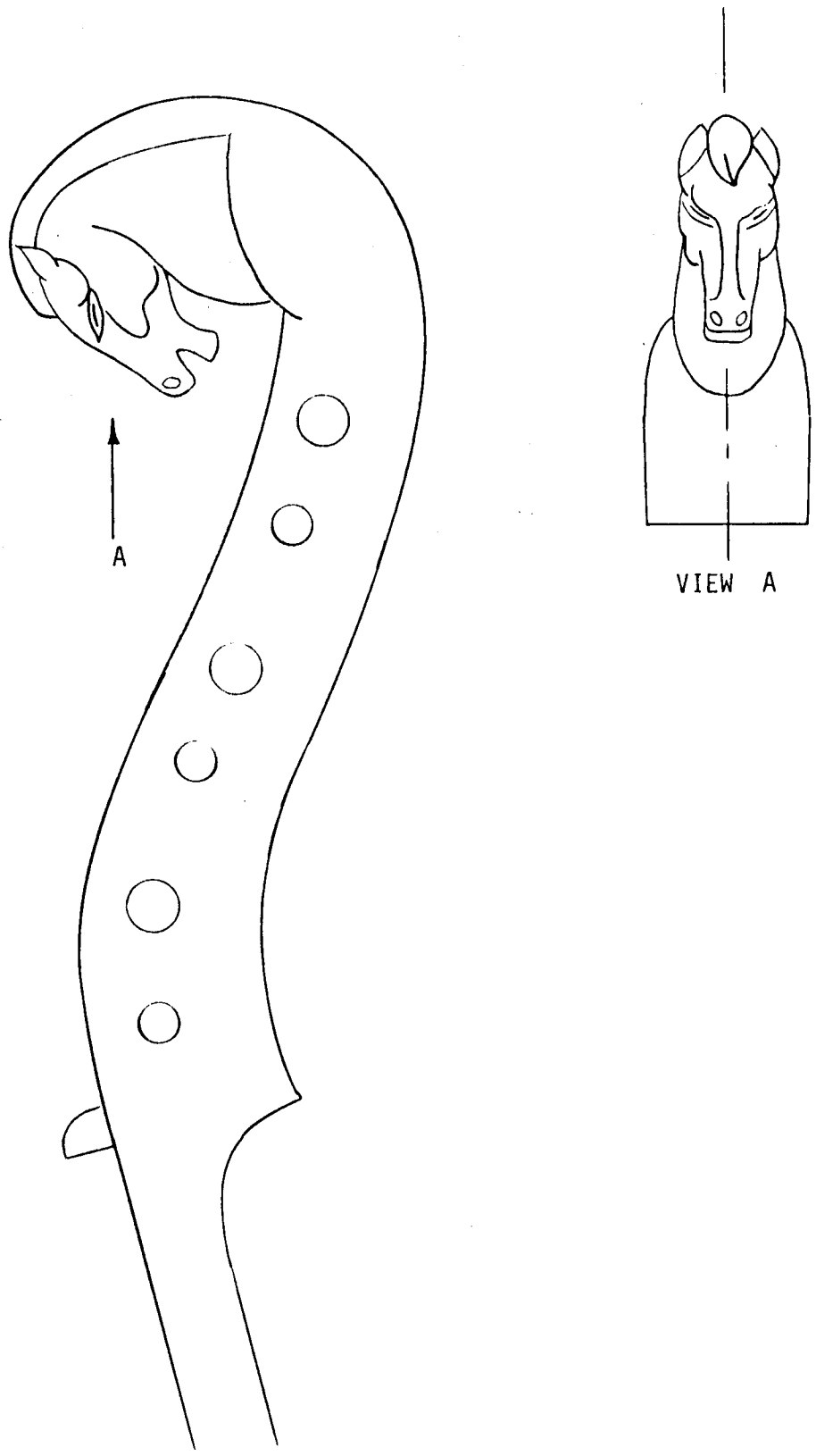


Figure 7-4. Carved Scroll

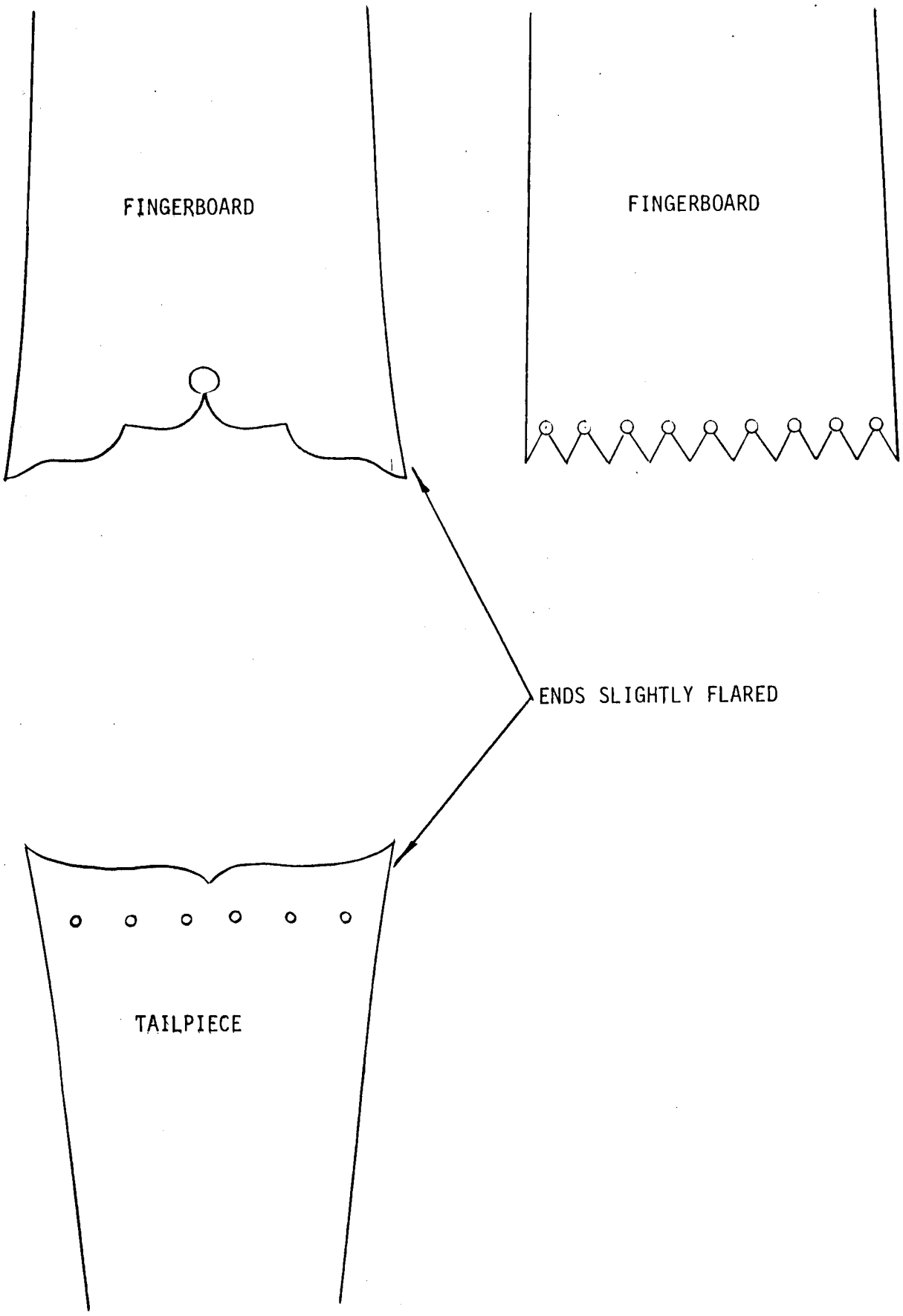


Figure 7-5. Tailpiece and Fingerboard Ornamentation

8. SOURCES OF SUPPLY

PLANS

Kelischec Workshop, Brasstown, N.C. 28902 - all sizes of viols, rebecs, lutes, violin, banjo, guitar, dulcimer, pasltery.

Musical Instruments Collection, Museum of Fine Arts, Boston, MA.- division viol, lute.

Conservatoire National Superieur de Musique, 14 Rue de Madrid 75008, Paris, France - plans for division viol.

TOOLS

Woodcraft Supply Corporation, 313 Montvale Ave., Woburn, MA. 01801 - graduating calipers, peg reamer, peg shaver, chisels, purfling cutter, clamps.

MATERIALS

Metropolitan Music Co., Mountain Rd., R.D. #1, Stowe, Vt. 05672 - all materials except specifically gamba strings.

International Violin Co., 4026 West Belvedere Ave., Baltimore, MD 21216.

E.O. Mari, 38-01 23rd Ave., Long Island City, N.Y. - Gamba Strings.

Albert Constantine & Son, Inc., 2050 Eastchester Rd., Bronx, N.Y. 10461 - rare and fancy wood, veneers, books, tools (purfling cutter).

Kelischek Workshop, Brasstown, N.C. 28902 - strings, pegs, bridges.

Gurian Guitars, Canada St., Hinsdale, N.H. 03451 - wood, purfling, pegs, inlays, etc.

International Luthiers Supply, Inc., P.O. Box 15444, Tulsa, OK 74115 - wood, pegs.

MUSIC

Provincetown Bookshop, 246 Commercial St., Provincetown, MA 02657 - tutors, viol music.

ASSOCIATIONS

The Viola da Gamba Society of America
New England Regional Chapter
31 Kilburn Road
Belmont, MA. 02178

The Viola d'Amore Society
1 Parkside Avenue
Wimbledon Common
London SW195ES, England

American Musical Instrument Society
17 Lincoln Avenue
Massapequa Park, NY 11762

American Society of Ancient Instruments
7445 Devon Street
Philadelphia, PA 19119

U.S. VIOLA DA GAMBA BUILDERS
(as of December 1977)

The Tourin Musica, P.O. Box 575, Waterbury, VT 05676 - all sizes of viola da gamba, custom built harpischords.

The Kelischek Workshop, Brasstown, N.C. 28902 - all sizes of viola da gamba from Pardessus to Bass, other ancient string and wind instruments, workshops on building and playing.

Donald Warnock, P.O. Box 265, Wilton,. N.H. 03086 - all sizes of viola da gamba, lutes, theorbos, guitars, citterns.

GLOSSARY OF TERMS

Shooting (a joint) - The edge to be jointed is clamped on a board or bench with a spacer underneath. A long plane, laid on its side, is run along the edge, both smoothing and squaring that edge to the lower surface.

Wolf Note - A dissonance, or harshness in a given note due to an instability in the instrument. A harmonic note is caused which is not of equal temperament with the note being played.

Viola d'Amore - An instrument of the viol family, having 14 strings, seven of which are fretted and bowed, the remainder of which lie beneath and vibrate in unison.

Ogee Curve - An "S" shaped curve.

In-Cannel Gouge - A gouge in which the bevel is located on the inside (concave) side of the blade.

Kerf - The slot or space left by a saw when cutting through the material. Kerf width is determined by the saw set.

Vellum - A strong, translucent drafting paper, used for drawing masters.

Sizing - The technique of coating a joint to be glued with a thin coat of glue (as a primer), which is allowed to dry, and which serves to prevent the wood from absorbing too much glue during the final glueing operation (thus "starving" the joint).

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7. "The Viola da Gamba", Nathale Dolmetch, Pub. by Hinrichsen, Ltd., N.Y. No. 759.
8. "Classical Guitar Construction", Irving Sloane, Pub. by E.P. Dutton, N.Y.
9. "Making Musical Instruments", Irving Sloane, Pub. by E.P. Dutton, N.Y., 1979.
10. "Antonio Stradivari, His Life and Work", Hill, Pub. by Dover Publications, New York.
11. "Handbook of Ornament", Franz S. Meyer, Pub. by Dover, N.Y. (Paperback).
12. "Music Monument", Thomas Mace, 17th Century (Reprint).
13. "Tutor for the Treble Viol", Francis Baines, Pub. by Gamut Publications, Cambridge, England (available from Provincetown Bookshop, Provincetown, Mass.)

APPENDIX

This section contains reproduceable,
full size drawings of the viol.