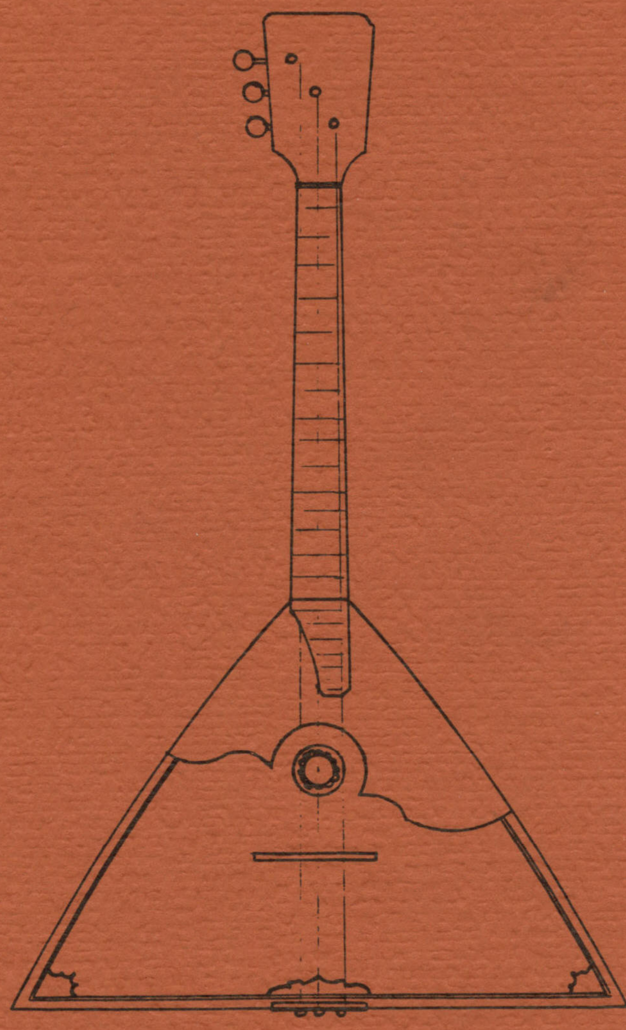
BUILDING *the* BALALAIKA



A Russian Folk Instrument

by James H. Flynn Jr.

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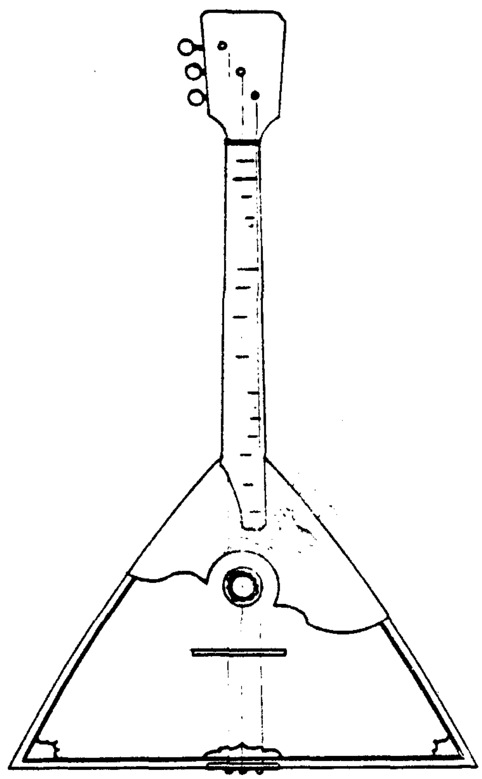

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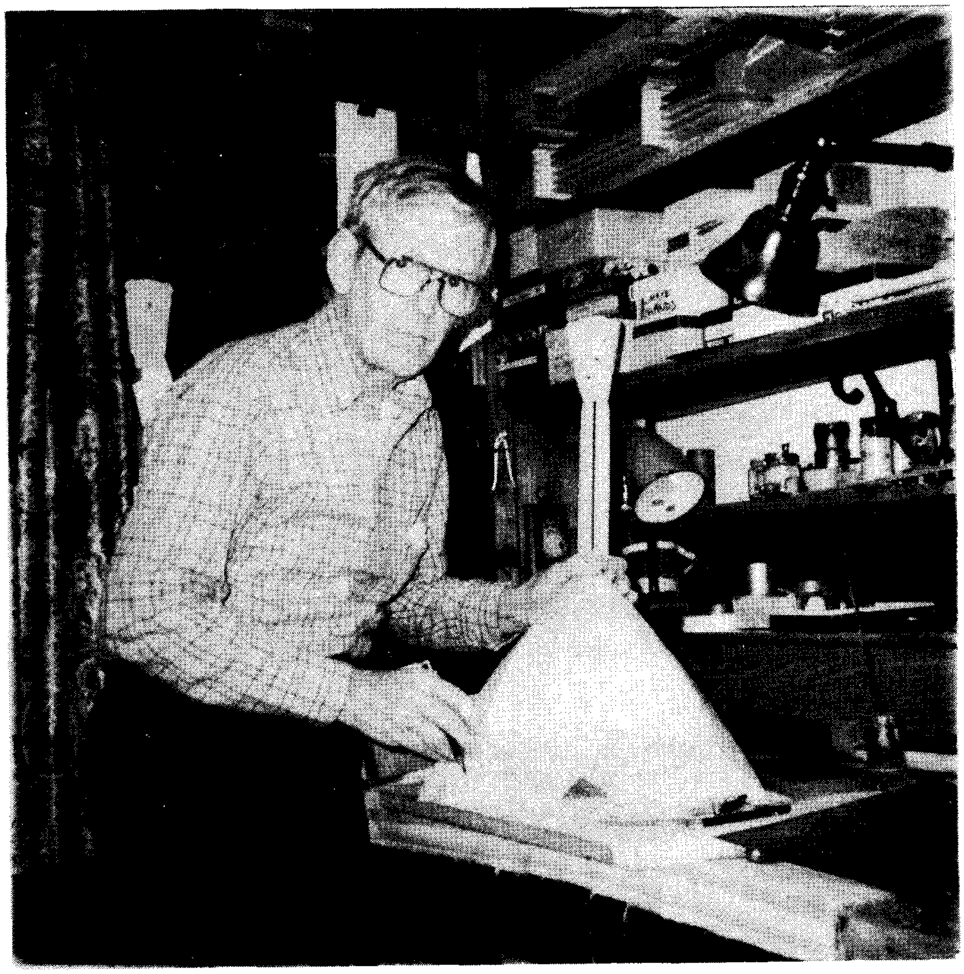

* * * Acknowledgements * * *

To my wife Mary...Thanks for everything. It was fun loading the VW bus with Engelmann spruce in Santa Fe and the pungent Port Orford cedar in Oregon...just to make more musical instruments! To our son Randy who did Russian translations for me when he was tired and weary...spasibo!
And we cannot forget Balalaika and Domra Association's Hall of Famer Gregory "Grisha" Titoff for evaluating some of my early instruments and giving me useful comments for perfecting them. We enjoyed the many hours spent with him.

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Introduction

Sitting here on the campus of the University of California at Berkeley in the summer of 1983 I am many leagues away from the Soviet Union, the native land of the balalaika. Nevertheless, beneath the tall pines and palms I can hear the ringing sounds of balalaikas and domras as members of the Balalaika and Domra Association of America (BDAA) strum their instruments in practice sessions at their fifth annual convention. The BDAA is a multi-ethnic association organized to perpetuate music written for the balalaika and domra and related instruments; to disseminate information pertaining to the musical and cultural heritage of Eastern European traditions; and to provide a forum for the exchange of ideas and developments concerning these instruments and their musical possibilities.

After much exposure to the balalaika and its music and chatting with some of the most talented players in the West, I feel that I should record some of the color and texture of these contacts. My objective, as an amateur luthier, is one of searching for and recording data pertinent to the building of the balalaika. I shall await another time to look at the domra. I was hopeful of obtaining a profile of what a true balalaika should look like as well as recording some of the personal preferences musicians may have in its design. With so many instruments available to me, as well as the opportunity to discuss their features with their proud owners, I believe that I was able to meet my goals.

Most players could recognize a "master" instrument...almost all knew what it took to make an instrument of high quality. I found instruments of superb craftmanship made by both Soviet and American luthiers. I was most pleasantly surprised to find that there are many balalaika makers in the United States and Canada. An even greater discovery was to find so many folks wanting to make their own instruments but lacking data from which to do so.

My hopes in preparing this publication are that it will provide those interested in the balalaika with some of the fundamental construction techniques as well as a description of the balalaika family with related dimensions. Above all, I would like to record this data in hopes of preserving the design of the instruments as the early Russian makers intended.

While I have no talent as a musician, I do have a keen attraction to the entrancing tonal quality of the balalaika. Working with wood and collecting a large variety of it has been a life-long hobby of mine, but my interest in musical instruments started after I retired from my profession as an operations research analyst. Living in Virginia, the Appalachian Mountain dulcimer was the natural instrument to gravitate toward. This truly American folk instrument still keeps my interests high but what more appropriate instrument to study next....the balalaika, the official folk instrument of the Soviet Union. Why?

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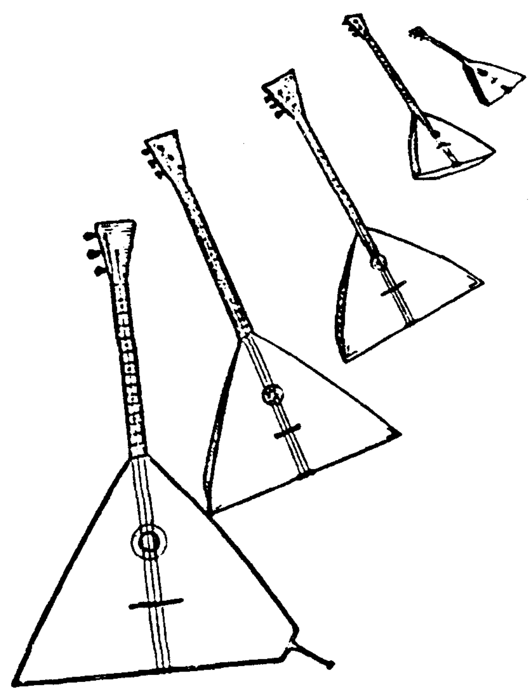


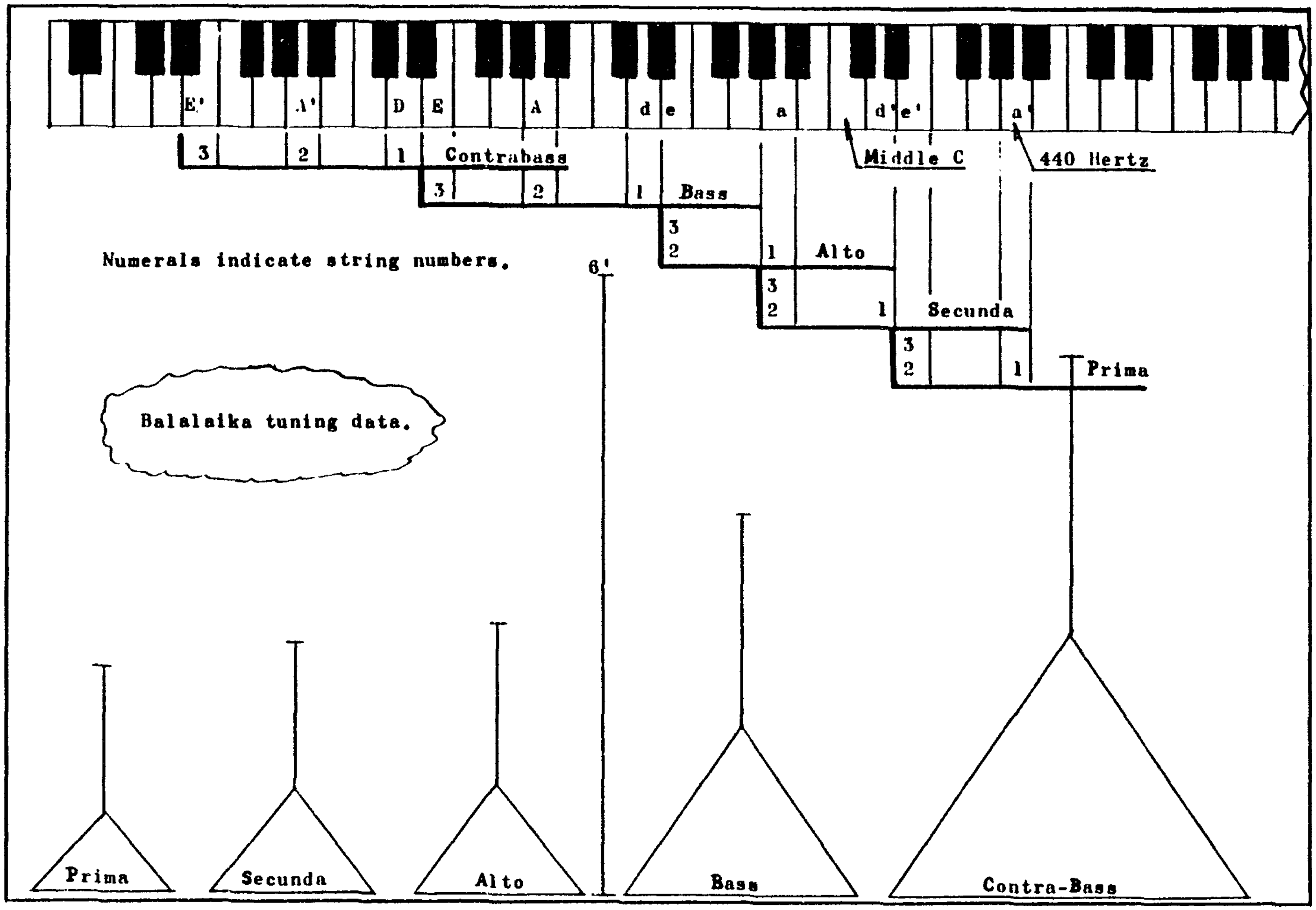
The Balalaika

There are many contemporary descriptions of the balalaika. I thought that it would be fitting to search out the official Soviet definition. The description is as follows;[1]

> "The balalaika: A two or three-stringed instrument with a triangular or oval shaped body, a relatively long neck with a head tilted back slightly. The overall length of the instrument is 600-700mm. The body of oval-shaped balalaikas is chiselled out; that of triangular ones is made of individual wooden slats. The top is flat, with resonator holes cut into it, often in a star-shaped pattern. There are five fret marks on the neck. The strings are gut; one end is held behind (on top of) the body with a peg; the other connected to a wooden key in the head. The basic tuning is a "forth" (if there are three strings, the second and third are tuned in unison). There is also a "forth-fifth" tuning, called "discordant", and the "guitar" tuning using a major and minor "third". Sound is produced by strumming all strings with the fingertips of the right hand, as well as plucking individual strings. The balalaika is a comparatively young instrument. The first mention of it in written sources goes back to 1715 (I. I. Golikov, "Supplements to the Works of Peter the Great," 1792, p. 242). It is possible that the instrument arose as a derivation or deviation from the domra, and, having gained a wide distribution, it quickly supplanted a number of other instruments, including the domra.
>
> Numerous cheap prints and folk illustrations attest to the popularity of the balalaika in country and city musical life. The application of the balalaika in the musical life of the people was diverse: song and dances were performed on it; it accompanied solo and ensemble singing; it was introduced into composition of various instrumental groups. In the 1880's with the leadership of V. V. Andreyev, the folk balalaika was perfected; on its foundation were created a number of orchestral instruments with chromatic scales - piccolo, soprano (later disused), prima, secunda, alto, bass, and contrabass. The first performance of a "balalaika club" took place in Petersburg (Leningrad) in 1888, after which balalaika (and after 1896 balalaika-domra) orchestras began to form with surprising speed all over Russia. The success of the balalaika in large part lay in its low cost and ease with which it could be mastered.
>
> Orchestras of Russian folk musical instruments have become particularly widespread during the Soviet period. Folk songs and dances, compositions of classical composers, both foreign and Soviet, all fall within their repertoire".

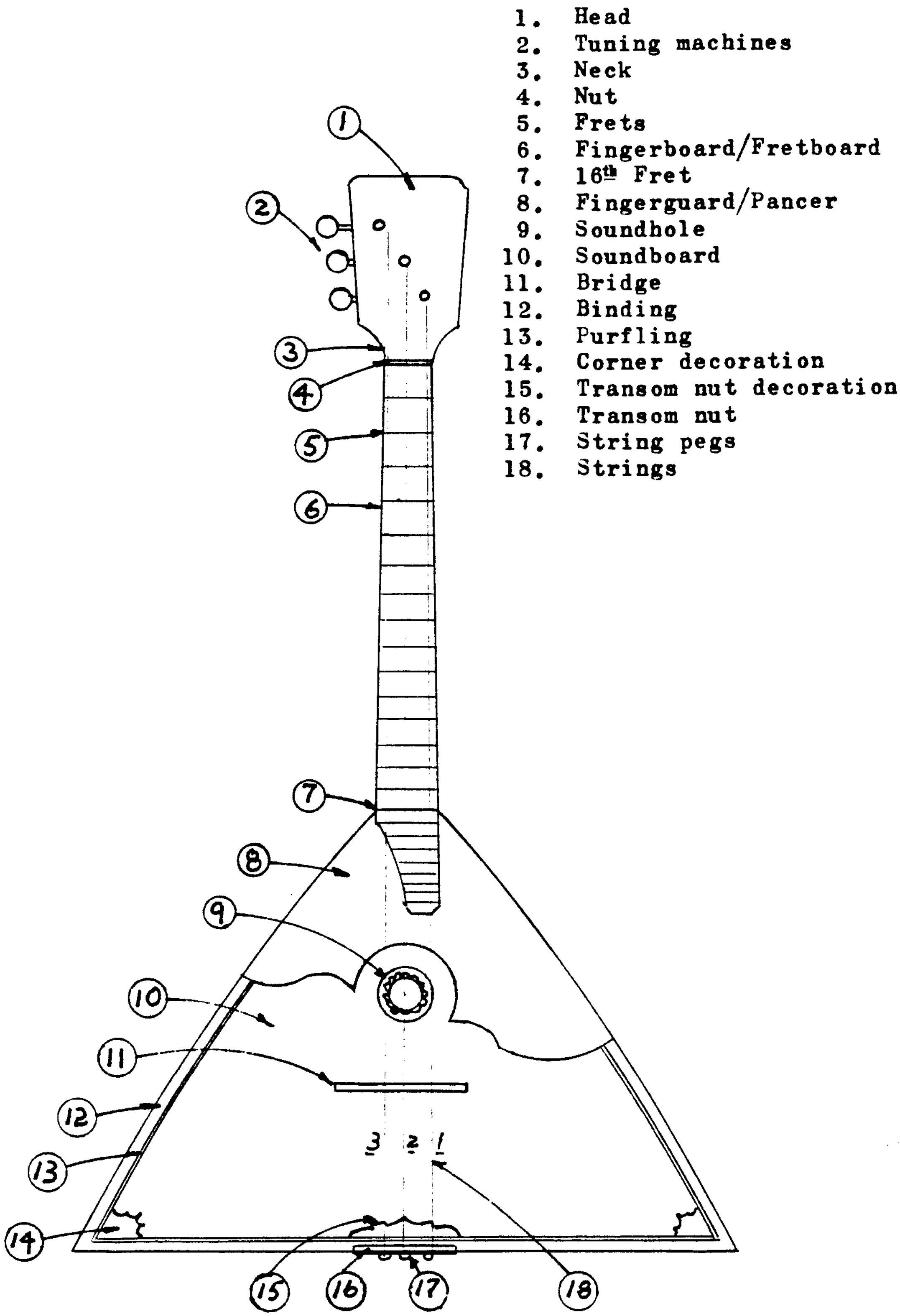
The tuning data on the balalaika is depicted in Fig. 1 and is related to the lower portion of the piano keyboard. Fig. 1 also scales out

[1] Vertov, K.A. Atlas of Musical Instruments of the Nationalities of the Soviet Union, Moscow, 1963.



E'
A'
D
E
A
d
e
a
d'
e'
a'
Middle C
440 Hertz
3
2
1
Contrabass
3
2
1
Bass
3
2
1
Alto
3
2
1
Secunda
3
2
1
Prima
Numerals indicate string numbers.
6'
Balalaika tuning data.
Prima
Secunda
Alto
Bass
Contra-Bass

Fig. 1



PARTS OF THE BALALAIKA

Fig. 2

the five instruments and compares their size with a six-foot measure. The parts of the balalaika are identified in Fig. 2.

This publication is limited to the general construction techniques useful in building a prima balalaika. Dimensional data for the complete balalaika family are listed in Table I which can be found in the appendix. One has only to determine the size of the instrument to be constructed and then apply the same building procedures to the scaled-up model. The basic profiles of the balalaika, which are shown in Fig. 3, remain essentially the same. One exception is that the bass and contrabass instruments do not have fingerguards of the type used on the smaller instruments. This is because of the manner in which they are strummed. Some of these larger instruments have a protective piece of veneer or plastic glued on the soundboard at critical locations where the soundboard may be damaged by scratches. The two large instruments have a collapsible foot installed in a cut off portion of the left corner of the body. The foot rests on the floor thus facilitating its playing in an upright position. The dimensions shown in Table I are fairly close to average sized instruments but some minor excursions in size (up or down) can be tolerated to suit individual needs.

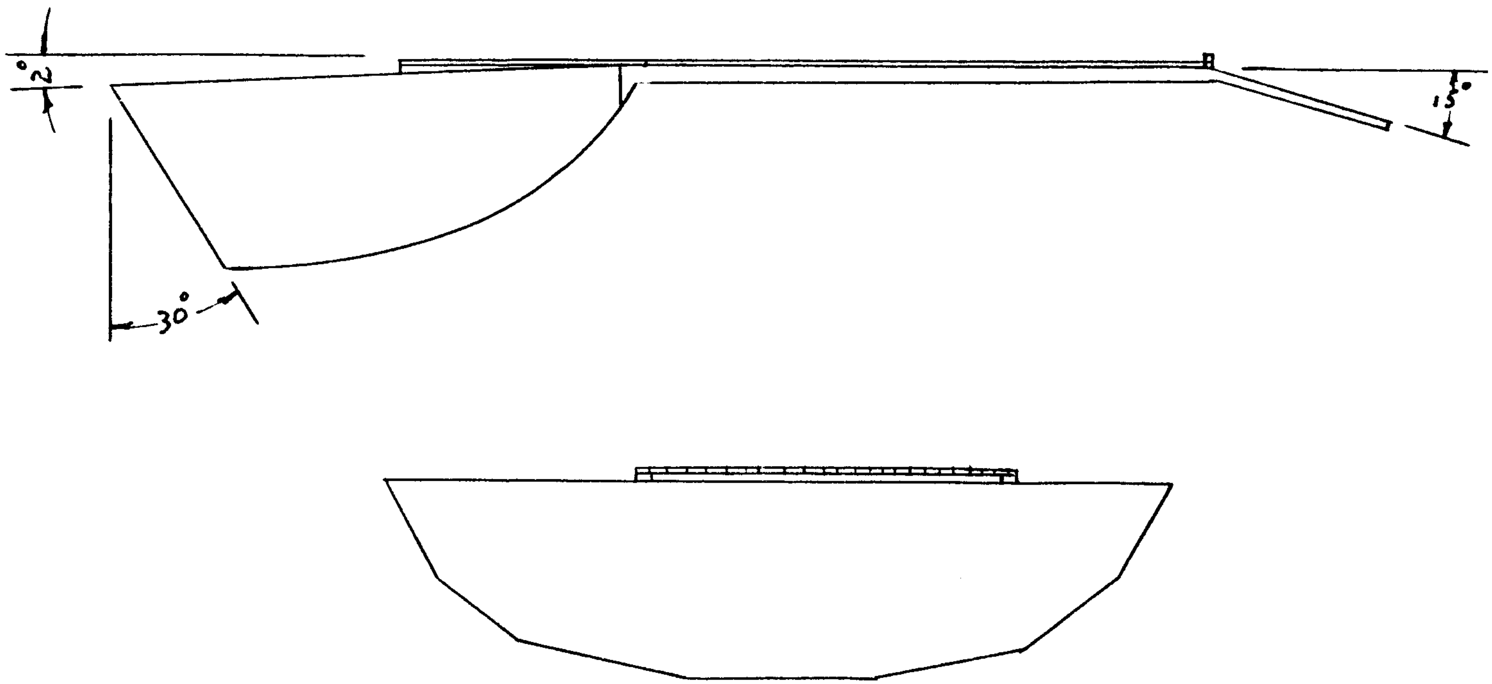
Because the balalaika has an official status in the Soviet Union as a "Folk Musical Instrument" builders are encouraged to faithfully follow the basic size and shape parameters. Severe ornamentation and flashy coloring is apt to produce a balalaika that looks tacky so artistically inclined luthiers should consider restricting their artistic impulses to:

a. small changes to the corner decorations and the inlay surrounding the string pegs and the lower nut;

b. tasteful changes in the decorational inlay surrounding the soundhole providing that the diameter specified is not changed;

c.minor changes in the corner cuts of the tuning head and placement of inlays in the head providing that the truncated triangular shape is maintained and that the posts of the tuning machines are in alignment with the strings as they pass over the nut;

d. layout of the veneer on the face of the transom.



Profile of the Balalaika

Fig. 3

Changes that affect the acoustical output of the balalaika are worthwhile from an experimenter's point of view. Examples would be in strut form and placement, bridge styles, curvature of the soundboard, etc. Such changes should be aimed at improving the resonating characteristics of the instrument, thus enhancing its volume and tone purity.

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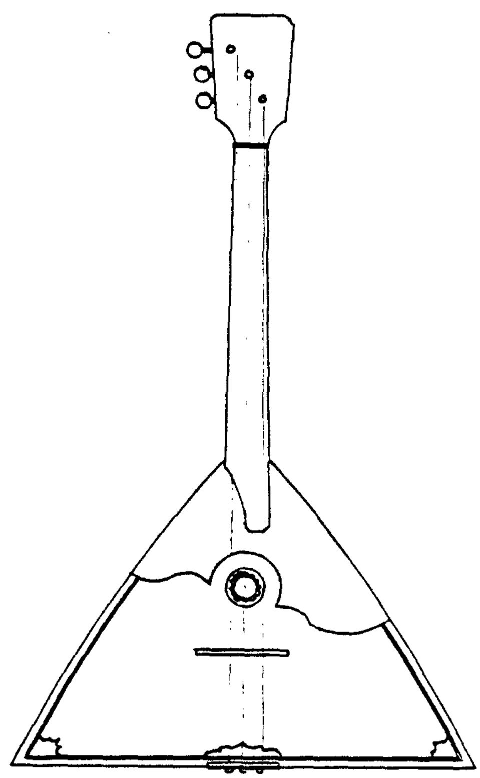


Wood

There is a piece of early American furniture, I believe a chest of drawers made in quantity, which is certified to be an antique when the side panels are split. No split...no antique...merely a reproduction. This splitting was caused by the joinery the cabinetmaker used. Specifically, he fastened a wide, vertically grained, side panel to a horizontally grained base. In time, the side panel eventually shrank with age and dryness, however, the base did not shrink in the same direction. Consequently, the side had to give way and crack under the strain. This sort of a situation is one of the most important things to keep in mind when working with wood. Wood is always moving. It moves in a stacked pile outdoors as well as in a delicate, fully constructed, musical instrument. When we speak of moving we mean that wood is changing dimensions. In some instances the changes are large as when freshly cut lumber is drying. In other cases the changes are small as in a musical instrument made with well-seasoned wood residing in a stable environment. These dimensional changes occur because wood is "hygroscopic", that is it absorbs and releases moisture as changes in humidity and temperature occur. Therefore, it is fundamental and essential that any item fabricated from wood be made from well-seasoned stock. This means with wood which has reached its "equilibrium moisture content."

Wood exposed to an atmosphere containing moisture in the form of water vapor will come, in time, to a steady moisture-content called "equilibrium moisture content" (E.M.C.).[2] Wood which has been seasoned in Santa Fe has a different EMC than that which has been cured in Washington, D. C. since these have different weather profiles.

Another way of looking at this is to consider that the EMC of wood exposed to normal conditions outdoors, but under cover, over much of the United States is about 12 to 15 percent. Under heated conditions inside buildings, the EMC will range from 8 percent to as low as 4 percent in mid-winter. For example, consider two cities with the same average temperature of 70°F but having differing relative humidity measures. The one with a 40 percent humidity would have wood with an EMC of 7.7 percent. The other city, with a high 80 percent humidity

[2] Panshin, A.J. and deZeeuw, C., Textbook of Wood Technology (McGraw-Hill New York, 1980)

would have its wood with an EMC up to 16 percent. This is why an understanding of "wood movement" is so essential to makers of musical instruments and other fine and delicate woodworking endeavors.

Wood does not change dimensions is all directions equally. There are three dimensions, or planes, in wood and they are identified in Fig. 4. Wood shrinks very little in the transverse plane. It shrinks

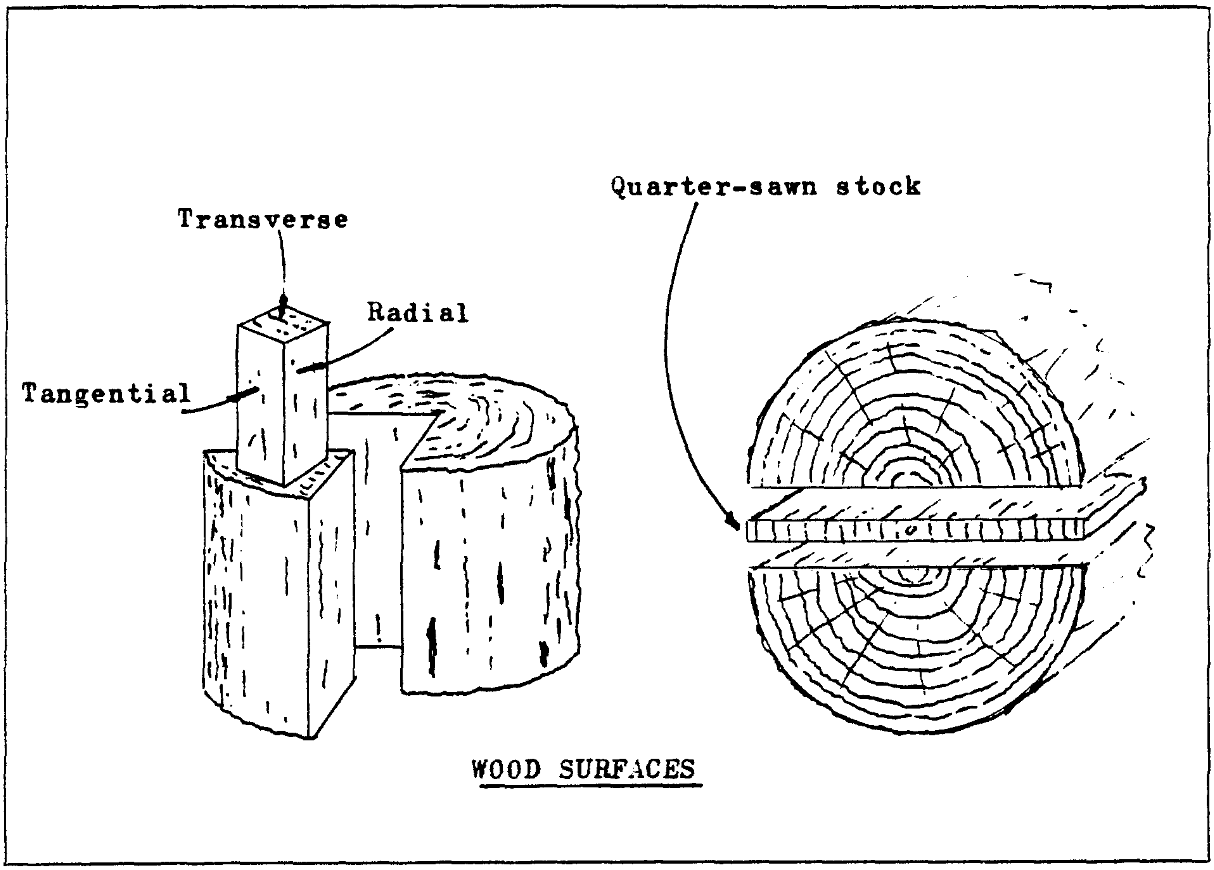


Fig. 4

greatest in the tangential plane and moderately in the radial plane. For example, in the tangential plane yellow birch (Betula allaghaniensis Britton) shrinks 9.5 percent in coming from the freshly-cut state to its EMC. In the radial plane it shrinks 7.3 percent. We must keep in mind that the greatest shrinkage in wood takes place in the time that it takes to reach EMC from the freshly-cut state. Some woods, even though they may have a higher shrinkage rate before hitting EMC often are very stable thereafter. The caution to be observed is that well-seasoned wood is essential to begin with; that some knowledge of its stability in its dry state be known; and, that grain orientation in placing together components of a musical instrument be carefully planned to maximize strength and stability. However, one cannot be guided solely on the dimensional stability of wood. Other factors such as bending, machining, stiffness, hardness, color, grain patterns, etc., cannot be excluded. It seems that the more you learn about wood the more cautious you may become but eventually you must make the decision as to what kind of wood best suits some particular set of requirements. References in the attached bibliography are highly recommended for more insight into the wood behavior story.

The selection of wood for the construction of the balalaika is not too difficult. For some, it is a fairly easy matter in that personal preferences are known ahead of time...it will be rosewood from Grandmother's old piano. For others, in attempts to build the perfect instrument, it may require a great deal of time and study to search for the ideal wood which has the optimum characteristics for each part of the instrument. An example of some of the decisions to be made in the selection of the soundboard is as follows. Prime consideration is that the soundboard be resonant at the frequencies appropriate for the particular instrument. This suggests "musical" wood such as spruce or cedar. The wood must be resistant to splitting,Sitka spruce being better than western redcedar. However, the western redcedar has a more vibrant color than does the spruce. The decision to use one or the other is left to the instrument maker but also, preferably, to the player. The most important thing is that such decisions be made with full knowledge of why they were made.

There does not appear to be any rigid conventions for the species of wood used for the body of the balalaika. If indeed there is a preference, it would be for hard maple. Either sugar maple (Acer saccharinum Marsh.) or black maple (Acer nigrum Michx. f.) being satisfactory. Highly figured wood with curly, birds-eye, quilted or crotch patterns tastefully placed and matched make balalaikas an instrument of beauty. The wood for the head and neck as well as for the smaller components such as binding, corner decorations, etc., should match or complement the wood used for the body. The fretboard, holding to convention and preferences of most musicians, should be made of ebony. Preference for hard maple for the body does not imply that other woods commonly used in musical instrument construction such as rosewood (Dalbergia sp.), hormingo (Platymiscium sp.), mahogany (Swietenia sp.) etc., are to be excluded from use in making a balalaika. In scoring the value of an instrument it is its musical quality that counts. The physical attractiveness of an instrument also rates highly and there is all the reason in the world to believe that the balalaika can satisfy both visually as well as musically. So have at it with the species of wood you decide to use!

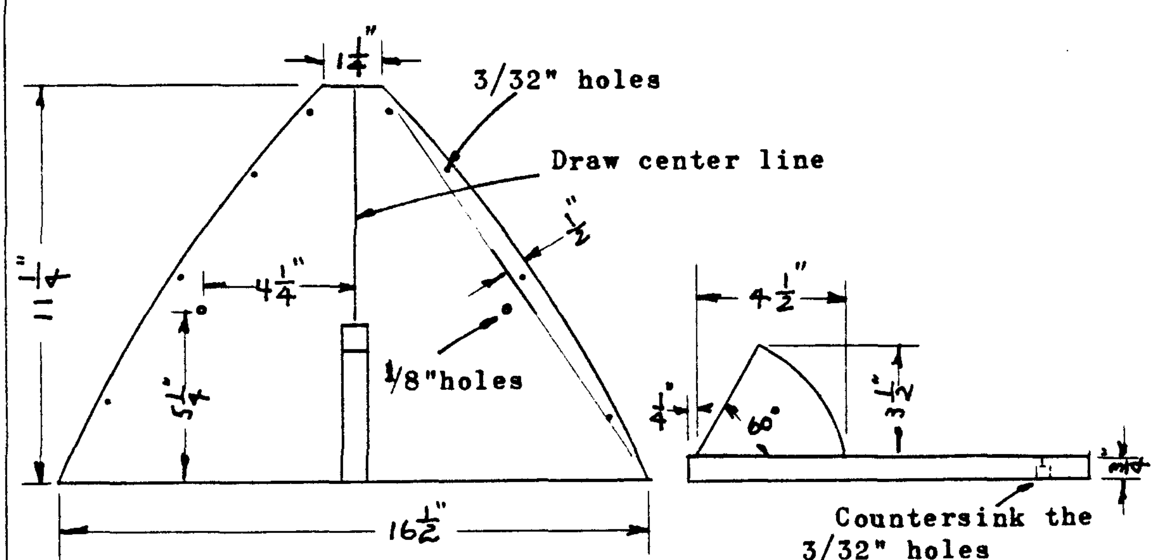
Old furniture, incidentally, is an excellent source of well-cured wood. One of the better dulcimers I made came from a mahogany mantle removed from an old estate in the Washington, D. C. area. Another example was last year when I was up in Maine and visited a second-hand furniture store in Portland. I found two beautiful bed rails made from birds-eye maple and offered the proprietor $5.00 for the pair. He didn't accept. The rails still sit there and the next time I visit the place I may make an offer of $10.00. I estimate that there is six board feet of usable stock in the rails. You can make an awful lot of prima balalaikas from two bed rails. They may even be worth $15.00! And to cap it all off, I estimate that the wood was over fifty years old.

* * *

The Body

So far, I have described the balalaika family and provided a brief history of the instrument. In addition, a discussion of wood-related issues has been provided together with some thoughts on design changes which would make the instruments distinctive. We can now begin with the hands-on construction phase. As I proceed I will attempt to describe the components of the balalaika in such detail so as to make it easy for those planning to construct an instrument other than the prima size. This will enable the builder to design the scaled-up components in the same manner as the smaller version.

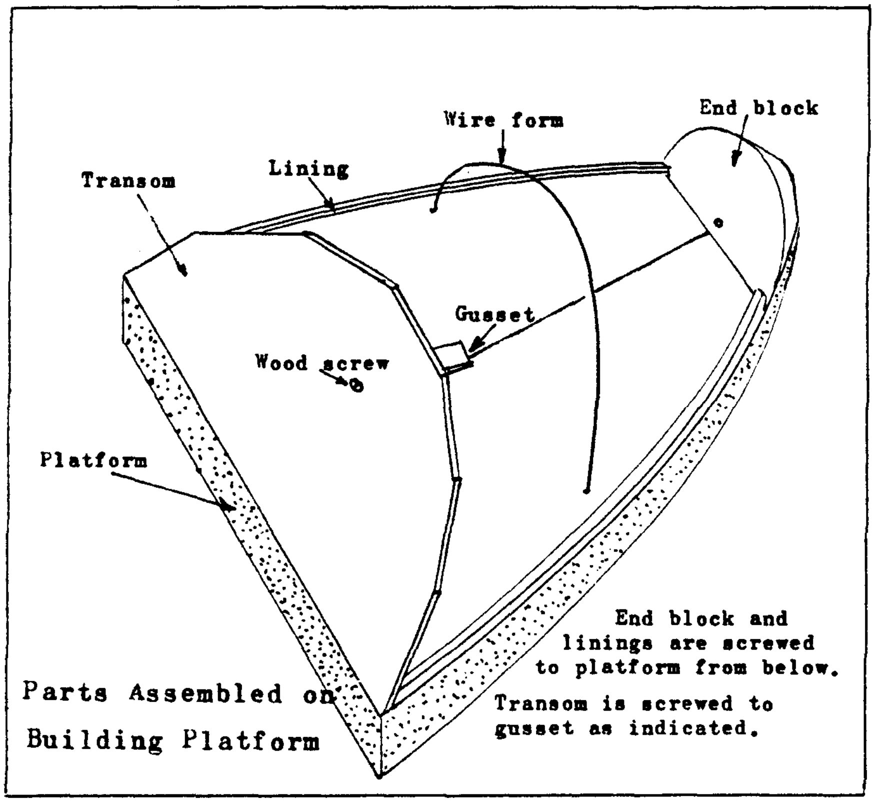
The first thing that we need is a platform upon which we can attach and shape the various components of the body. It can be called a mold although it is a rather skeletonized one. The platform is made from 3/4" chipboard. Plywood can be substituted if available. Just keep in mind that we are looking for a solid non-warping surface. Kitchen cabinet shops accumulate sink cut-outs that can usually be obtained for the asking. They are surfaced with formica and make nice platforms. The shape and dimensions are noted in Fig. 5.



BUILDING PLATFORM

Fig. 5

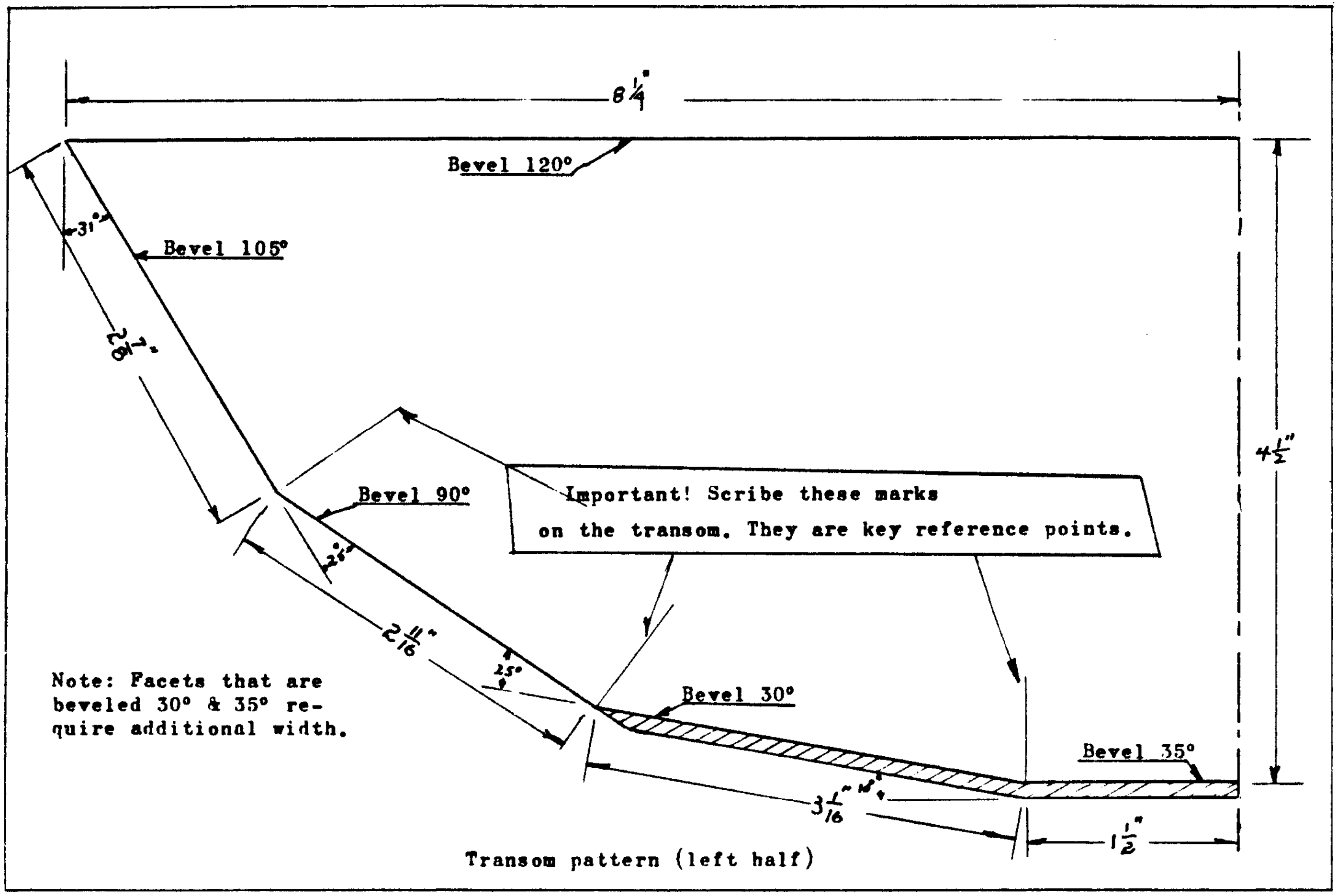
Before cutting it to shape, scribe a line on its surface in the exact center of the platform as noted in Fig. 5. This mark will be used as an alignment reference during the assembly of the body. Attach the transom support block (gusset) with screws from underneath. Keep the dimensions to a close tolerance as the platform will determine the top outline of the instrument. Put the platform aside while you cut the transom, side linings and shoulder (end) block. Fig. 6 shows these parts and where they relate.



Parts Assembled on Building Platform

Fig. 6

Here comes the first design option. Do you want a solid transom or one which is veneered? If you have an unusual piece of hardwood 1/4 x 4 3/4 x 16 1/2" with an attractive and symmetrical grain pattern, then go the solid route. If you prefer the transom to be more decorative by veneering pie-shaped wedges on the face then go that way. I personally find that the veneered transom is more attractive and preferred. Going the veneer route you will need a piece of light well-seasoned wood 3/16 x 4 3/4 x 16 1/2". I have been using some yellow poplar (Liriodendron tulipifera L.) from a seventy five year old porch pole. A tight grained piece of softwood such as spruce makes a fine transom base. Do not use a heavy hardwood as you will be adding unnecessary weight to the instrument. Cut the transom in accordance with the dimensions indicated in Fig. 7. A convenient way



Transom pattern (left half)

Fig. 7

of doing this is to make a tracing paper pattern and lay it on one half of the transom. With a sharp pointed instrument, pierce the paper at the apex of all angles thus making a mark on the wood. Reverse the pattern and make similar marks on the other half. Then draw lines to each of these points as the pattern suggests. Do not cut the wood at this point as you will notice that these cuts are not at right angles. I cut my transoms on a band saw and make necessary angle adjustments with the table. Proceed to cut the shape of the transom after the above caution has been noted.

Please take note that we have elected to make a seven (7) rib instrument. Table I indicates that the prima balalaika can be either a six or seven ribbed instrument. Also pay particular attention to the notes shown in Fig. 7, especially the need to make pencil marks on the transom at the angles where each rib joins another. This is necessary because in the process of fitting the ribs to each other and at the transom, some light sanding and scraping may be necessary, thus making the location of the apex unclear. Making the transom is one of the tricky components of the balalaika and apt to cause some consternation. If you look at the transom broadside it follows the lines of an ellipse. The ribs are chords on this ellipse and herein lies the problem. You can divide this elliptical "half" curve into seven equal chords (segments) for the ribs. When doing this you end up with a different angle where each rib joins its adjacent one. With a seven ribbed instrument this requires three different bevels (three joints on each side of center) where the ribs butt each other. Further, the angle between the center rib and the two on each side of it is very slight. I prefer to reduce the number of different angles for butting the ribs by making the ribs slightly dissimilar in width as they join the transom. Further, the angles are then workable ones. There is room for experimenting here and no sacred design is prescribed. Put the transom aside for the moment.

Making the two side linings is the next step. In lutherie terminology, a lining is a strip of wood used on the inside of an instrument to enlarge an edge so as to provide a wider surface upon which the top or bottom is glued. The side linings for the balalaika are made from 1/2" square spruce (or other suitable species) and are bent

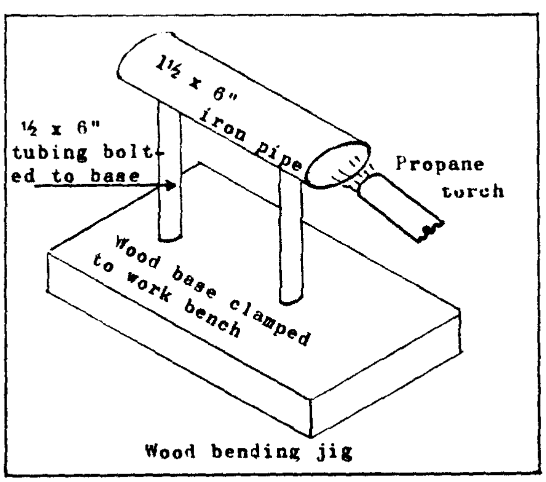


Fig. 8

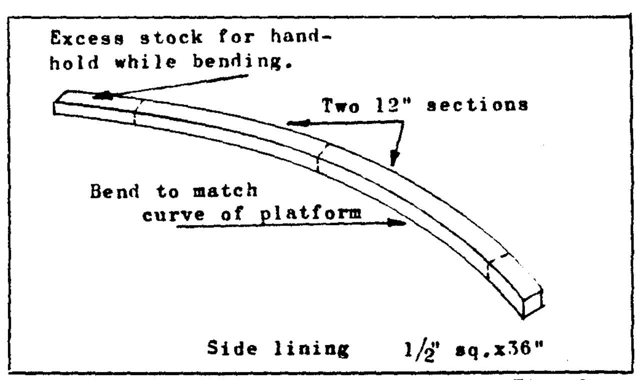
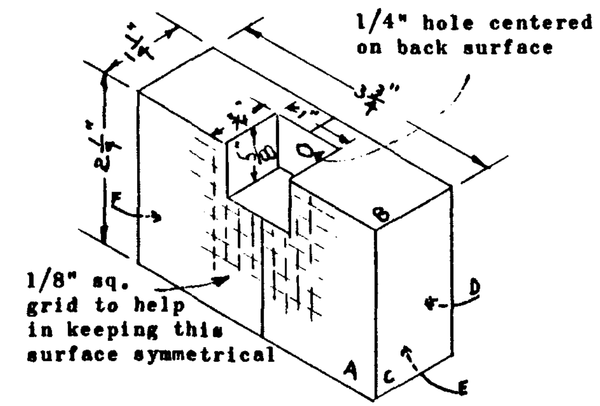
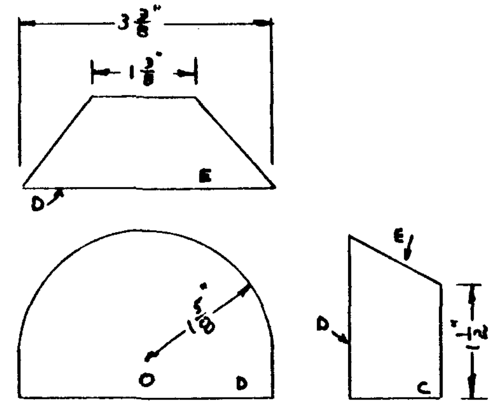
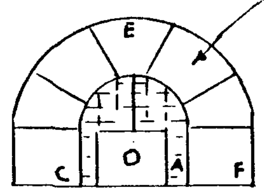


Fig. 9







When fitting the ribs these curved surfaces are dressed flat.

END/SHOULDER BLOCK

1. Pencil-in a permanent line around the girth of a block of wood 1¼ x 2¼ x 3¼".
2. Cut a mortise as indicated and drill a ¼" hole in position shown.
3. Note that the *faces of the block have been* labeled with letters. Around the mortise, on face "A", pencil-in a grid of 1/8" squares. These guide lines will help in keeping this *face symmetrical*.
4. Cut away excess stock to shape the block to the dimensions shown above.
5. Surfaces "C","E" & "F" are now one continuous curved surface. Mark approximate rib positions as shown. File/chisel these surfaces when fitting the ribs.

Fig. 10

on a hot iron. Lets take a moment and discuss the assembly of a home-made and effective bending rig. This is shown in Fig. 8. I clamp this iron to the workbench and clamp a 14 oz. propane cylinder in a vise and aim the burner head into the pipe. I place scraps of metal in the pipe to act as baffles and diffuse the flame. Now back to the linings.

Uncover the platform you laid aside earlier. Moisten the 1/2 x 1/2 x 36" piece of lining and bend it over the hot iron to conform to the shape of the curve on the platform. See Fig. 9. While this piece is a little long, it will produce a lining for both sides with enough to hold the wood while it is on the hot iron. In operations such as this I generally make a few extra pieces. It is much more economical in terms of time to crank out several pieces while the special rig is set up. The lining is now curved and square. It will be trimmed after the ribs are in place and then cut down to a triangular shape. Do not be concerned with compression cracks on the inside of the curved surface which occur during the bending process. Set the linings aside but keep the platform handy.

The shoulder block (end block) is the next component to make. It is an odd shaped rascal and rather tricky to fabricate. Start with a rectangular block of tight-grained, light-weight wood (again, I like to use yellow poplar) 1 1/4 x 2 1/4 x 3 3/4" with the grain end on the narrow surface. Refer to Fig. 10 for a pictorial of how this block eventually gets shaped into the shoulder block. Keep these dimensions to a high tolerance as they will affect the setting of the neck.

Now the linings, transom and shoulder block are to be assembled on the platform. However, before we do this, it is necessary to build up the edges of the transom upon which will be glued the ribs. This is done by gluing a 1/8 x 3/16" lining on the inside surface of the transom at each facet that will join with a rib. Glue these rectangular strips to the transom as indicated in Fig. 11. I use Franklin Titebond glue for this purpose. (This applies to all other references of gluing unless stated to the contrary.) On the center and the two adjacent ribs be sure to extend the lining beyond the beveled edge and later plane it flat with this surface as well as with the other rib surfaces. In dressing these edges with a block plane, you will see why it was necessary to scribe pencil reference marks on the transom where the rib angle changes.

Carefully place the shoulder block in its proper position on the platform and attach it with small screws from underneath. Keep the block centered and in proper alignment. Attach the transom to the transom support block (gusset) by drilling a hole through the transom and screwing it to the block. The hole in the transom will be plugged later and covered with veneer. For those using a solid transom, drill this hole near the top of the transom (long edge) where the peg for the middle string will be located. Fit the side linings snug against the transom and the shoulder block. If the curve you bent in the lining does not quite match the contour of the platform this is not a matter for concern. Make sure that the lining is even with, or extends beyond, the edge of the platform. Place a spot of glue on the ends of the linings as they butt the shoulder block and transom and then screw them in place from underneath. Excess stock on the lining should now be trimmed off with a small plane and dressed to conform to the outline of the platform. See Fig. 6.

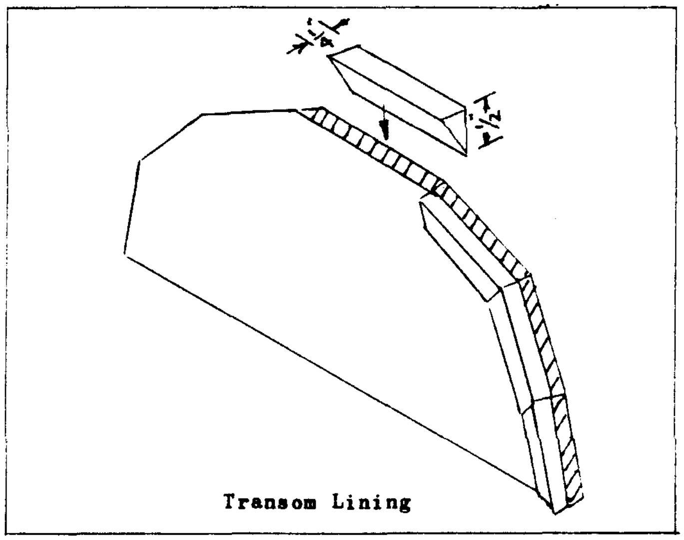


Fig. 11

We have one more attachment to affix to the platform before rib cutting time. Please note the side profile of the balalaika in Fig.3. Note the graceful curve of the body as it flows from the transom to the shoulder (or heel if you prefer). To get this line it is helpful to add a stiff wire to the platform to assure that the curve is most pronounced on the center and the two adjacent ribs. Drill two holes in the platform the size of a heavy wire (approximately 1/8" diam.) as shown in Fig. 5. Steel wire is best because of its stiffness. A bail from an old bucket does fine. Bend the wire to the approximate shape shown in Fig. 12 and insert the ends in the two holes we have drilled in the platform. We need not be too concerned at this time with the linesof the two outer ribs. The curve of these ribs will be governed by the shape of the platform. Some latitude is permitted here in forming the shape of the body. A deep or shallow body may be sought in attempts to improve the resonance of the soundbox. The wire will serve as a guide in scribing the light cardboard rib patterns and, at a later time, in gluing the finished ribs in place.

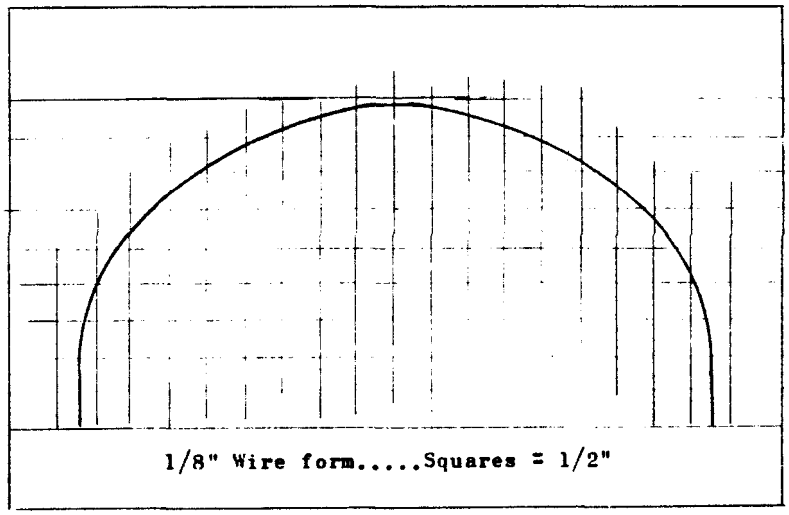


Fig. 12

I highly recommend making your own rib patterns. First, they will be easier to fit because of the experience gained in shaping them,and second, the knowledge will be helpful in making the larger sized instruments. Poster board makes good stock for rib patterns. Paper stock slightly heavier than the cover of this publication is a good weight to use. If you plan to make several instruments it would be well to cut the patterns from a thin aluminum such as roof flashing material. On a seven-ribbed balalaika we will need four patterns. The center rib is a one-half pattern split on the center line. Before laying out the patterns, the end block must be marked with the position of each rib as it hits the small end of the block. Remember that the small end of the block was gridded as illustrated in Fig. 10. This will help in marking the rib edges accurately. The outer ribs are 3/4" high at the end block. Mark these positions on both sides of the block. Now divide the remainder of the block into five equal segments. The location of the seven ribs as they terminate at the small edge of the end block are now identified. Next locate the pencil marks made on the transom as noted in Fig. 7. Carry these marks forward on to the transom lining. These are the edges of the ribs as

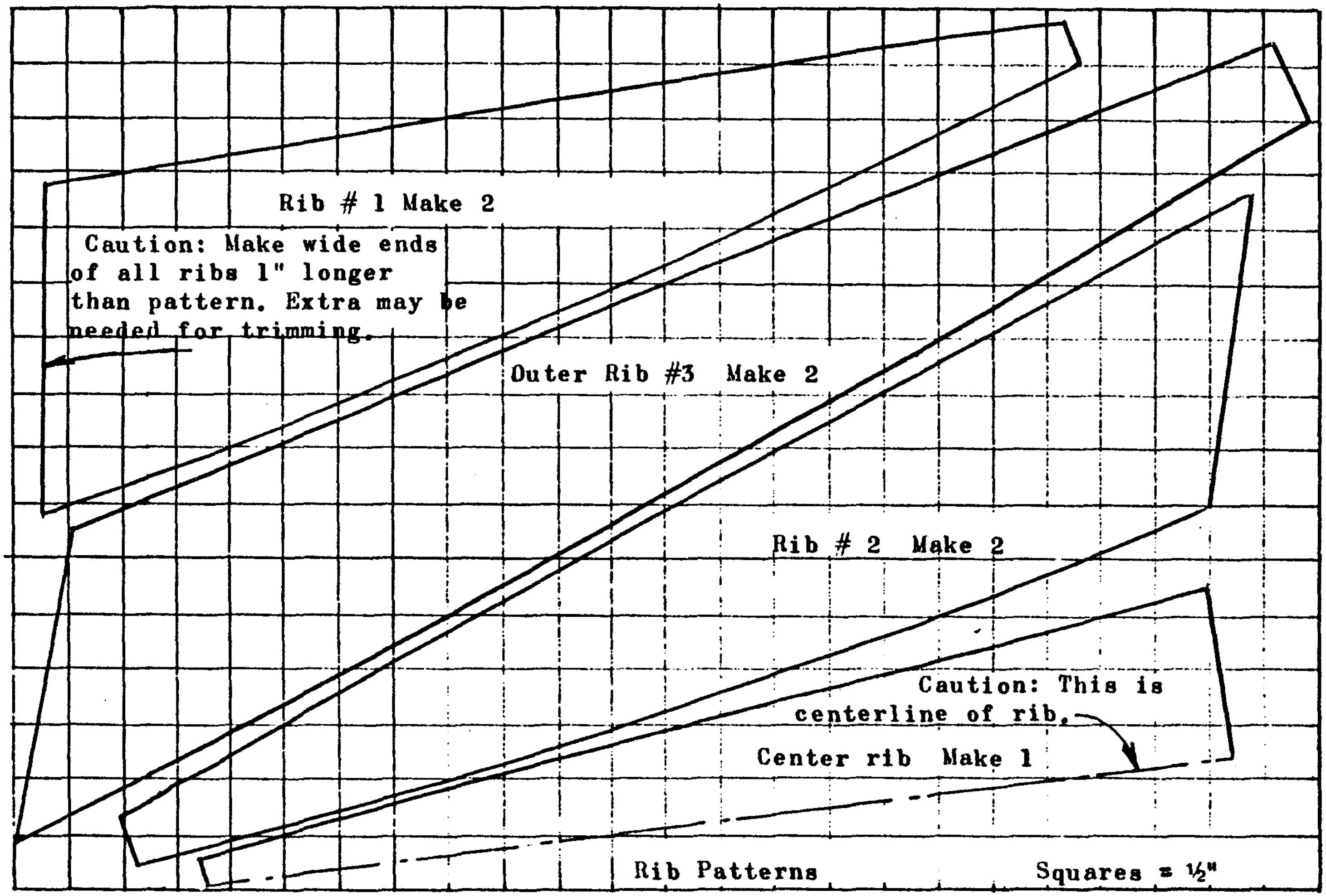

Rib # 1 Make 2
Caution: Make wide ends of all ribs 1" longer than pattern. Extra may be needed for trimming.
Outer Rib #3 Make 2
Rib # 2 Make 2
Caution: This is centerline of rib.
Center rib Make 1
Rib Patterns
Squares = ½"

Fig. 13

they will be positioned on the transom. Cut an over-sized blank pattern and thumb tack it in place on the outer edge of the platform along the lining, the end block and the transom. This is identified as rib number one. With a sharp pin-like instrument pierce the pattern from underneath at four points. Two points will be at the lining/transom and the lining/end block locations. The other two points will be at the end block and transom marks. Keep the pattern in place. Place a flexible straight-edge (a piece of poster board is satisfactory) at the two bottom pin holes and draw a line between them. Do the same at the two higher points being careful to keep the natural contour of the rib. You may need two pairs of hands for this operation. Remove the pattern and cut along the marked lines. This is the pattern for the two outer ribs...one left hand and the other right hand. The top edge of the pattern for rib number one is now marked on the bottom part of the next higher rib...rib number two. This edge is now cut. Thumb tack pattern number two in place and mark the two upper edges as was done before and mark its contour. Continue the process until all patterns are made.

Fig. 13 provides the patterns for the ribs. It is best to have the stock for the ribs worked down to the approximate finished thickness before cutting them to shape. One-eighth of an inch is a good average for hard maple. Softer wood should be a bit thicker and harder wood such as rosewood perhaps a bit thinner. Make full-scale patterns from Fig. 13 and observe the cautionary note that states that the wider part of the rib extend at least 1" beyond the pattern. The reason for this is that the pattern is the actual size of the rib when it is finished. Making them longer allows sufficient stock to bevel the edges and have a margin of safety in the event that the ribs must be reshaped slightly when they are being fitted. I found that the best way to cut them to shape is with a bandsaw or coping saw, cutting them within 1/8" of the final shape. A small hand plane is then used to shave the edges down to the final dimension. In laying out the pattern on the wood be sure to take advantage of the wood grain, especially if you are using a figured maple. Do not mix ribs of straight grain with those of a wavy pattern. Take advantage of the flow of the grain pattern so that it is balanced on both sides of the center rib. It is good practice to cut a couple of spare ribs while the stock is handy because you may encounter difficulty later on and damage a rib. This is especially true when bending and twisting them to shape.

You now have seven ribs cut to shape but not beveled. Sand and scrape the best surface of each rib but not to ultimate perfection. Put a noticeable mark such as a large "X" on the inside surface of each rib to prevent using a right-hand rib on the left-hand side as well as cutting the edge bevels on the wrong side. Refer to the illustration of the transom in Fig. 7. Notice that two of the rib joints are at a 25° angle and one at a 10° angle. On a seven rib balalaika, six joints are required...four at 25° and two at 10°. We must now make two guide blocks for a jig to cut these bevels accurately. The blocks will have a 12.5° and 5° angle which is one-half of the angle of the ribs to be joined. These blocks are illustrated in Fig. 14. The blocks are clamped on the sole of a plane and the

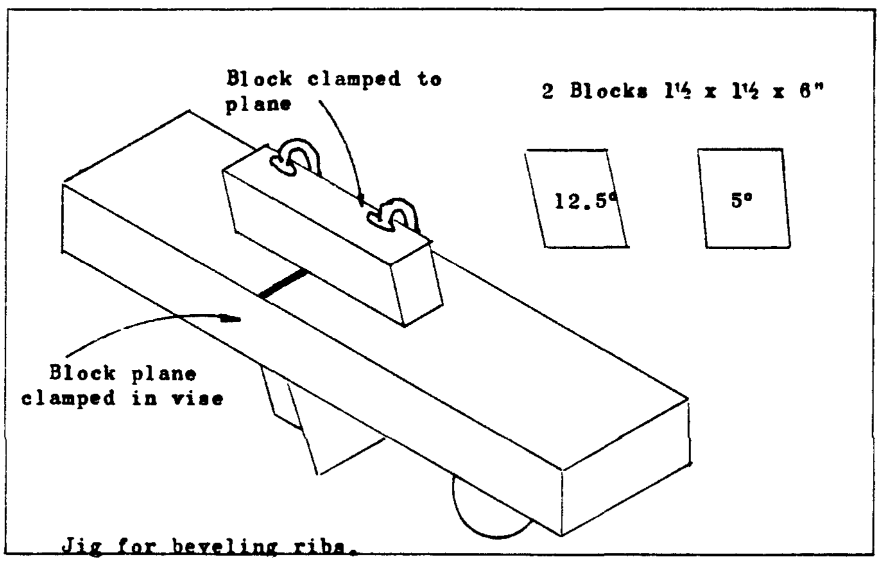


Fig. 14

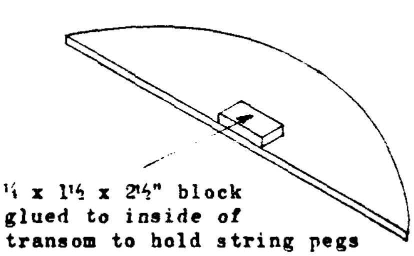
plane in turn is clamped in a bench vise. It helps to write the angle you plan to plane on each edge of the inside surface. Now pass the edge of the rib over the blade of the inverted plane,using the tapered block as a guide, and bevel the appropriate angle on all ribs. Either side of the block can be used depending upon the grain structure of the wood.

The ribs must now be bent and twisted so as to conform to the shape of the platform and fit between the end block and the transom. The hot pipe rig suggested in Fig. 8 is satisfactory for this bending operation but I find that a 150 watt soldering iron (not a gun) clamped in a vise will do equally well. The iron is used without a tip and the wood run across the tube holding the heating element. Not much heat is needed to bend the thin ribs. Do not wet the ribs nor use too much heat. The iron is too hot when the wood begins to char easilly. Start with the two outer ribs first. Gently slide them over the hot iron while bending the curve and twisting them to shape. When they are correctly formed it may be necessary to trim the end block slightly for the best fit. Always start clamping them in place at the end block first. This end of the rib can best be held in place by devising a small softwood block which is shaped and bolted through the hole on the end block. By tightening a wing nut on this bolt the wood will grab the end of the rib and hold it tight. The outer ribs can be clamped to the side linings rather easily. The rib-to-transom clamp is 3/4" strapping tape (transparent tape with threads running through it). Apply the tape to the rib and pull the rib into place and secure the end to the transom. Use as much tape as necessary to get a good tight bond with the edge of the transom. Be sure to keep the top edge of each rib aligned with the pencil mark we have inscribed on the transom. Do both outer ribs and rest awhile.

On the top surface of the outer ribs glue a strip of ebony veneer (or other contrasting wood) and hole it in place with strips of masking tape until the glue is set. Bend and twist the next two ribs into shape and glue them in place. It may be necessary to make slight adjustments in the curvature of the ribs to conform to the rib already in place. Do this by hand-planing the lower edge of the rib to be fitted. You will probably encounter a problem in that the rib being bent will conform to the shape of the rib in place but the end bearing on the transom will not lay flat. No matter...as long as it is within 5/8" of home. Again start gluing and clamping from the small end of the shoulder block then back towards the transom. Use the strapping tape to pull the edges together. Do not skimp on tape. When the edges are butted tightly, pull the wide end of the rib down tight on the transom with more tape and you will find that the rib will buckle into place. Follow the same procedures for the rest of the ribs. The center rib requires joining on two edges. I have always found that the shape of this rib must be adjusted slightly for a tight fit and then teased into place. Fortunately, the rib is in the form of a wedge and shaving the edges merely lets it slide forward toward the end block as the fit becomes tighter. Here is where the extra length comes in handy. When the rib fits to perfection, it is glued and pressed into place using a heavy weight to keep it pressed against the adjoining ribs. Strapping tape is also used to help with the alignment. The edge of the rib as it hits the transom can be clamped by spanning a clamp from the rib to the bottom of the platform.

The body is now separated from the platform by removing the screws from underneath the platform and gently tapping the units apart... like removing jello from a mold. A rough looking balalaika is now taking shape. The portions of the ribs which extend beyond the transom will now be removed. Do not cut the ribs which extend beyond the edge of the shoulder block at this time. I use a Dremel Moto-Tool inserted in a router attachment for this operation. A saw tool inserted in the chuck neatly slices away the excess rib stock. A fine-toothed flat saw, carefully manipulated, will work as well. After the excess rib stock has been removed, the surface of the transom can be trued up by running it across the surface sander described in a subsequent paragraph. Be especially careful not to splinter the outside surface of the ribs in this operation.

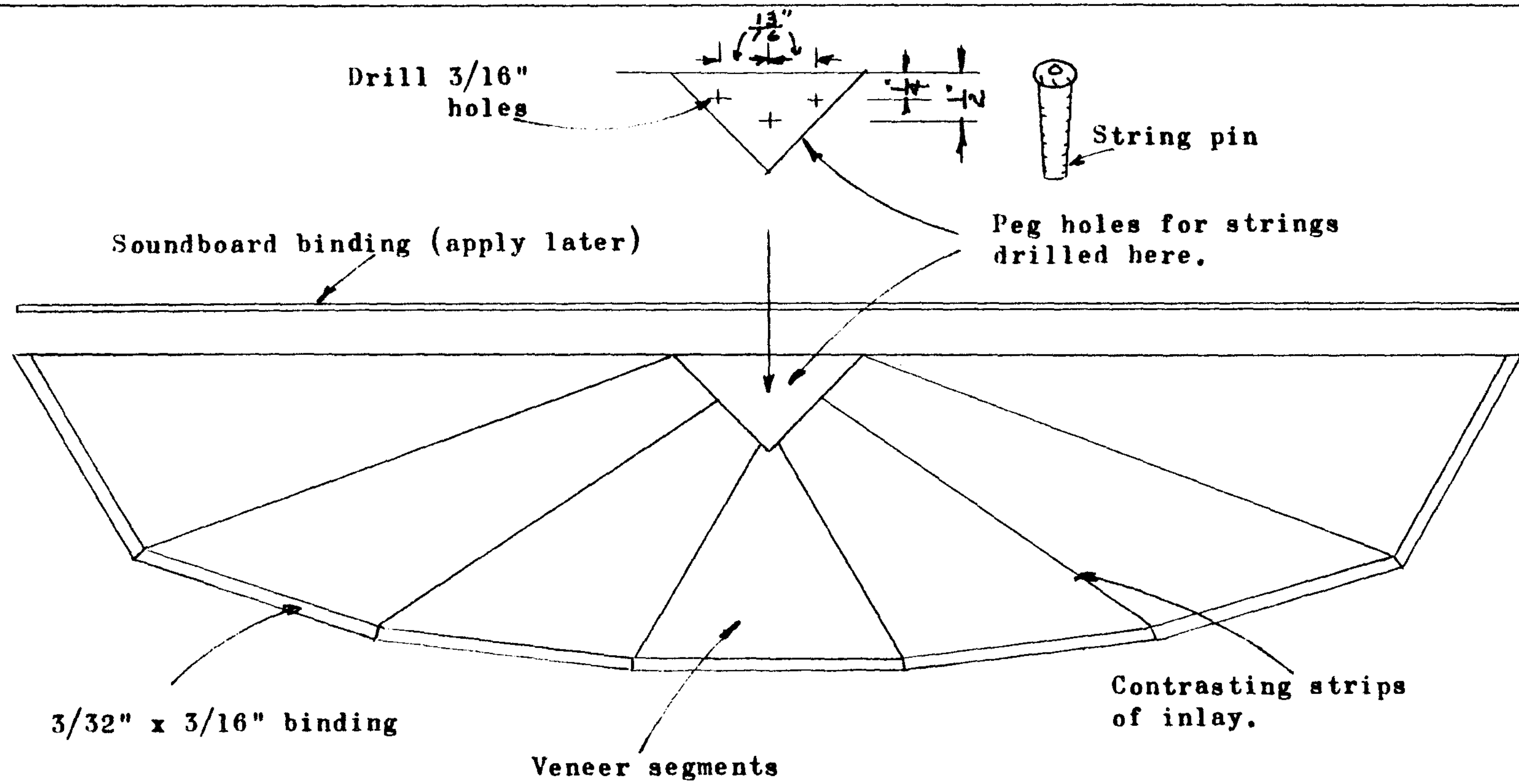
A block of hardwood of the dimensions and shape of that shown in Fig. 15 is glued to the inside surface of the transom. This block is needed to hold the string pins which will be discussed soon. After this block is glued in place, install a 1/4" triangular piece of lining to the top edge of the transom to widen the gluing surface to approximately 1/2".



String Pin Block

Fig. 15

Fig. 16 shows an example of a veneered transom. The pie-shaped wedges seem to be traditional but other designs can be used. It is preferable, but not mandatory, that the same species of wood used



Suggested veneer layout for transom. The contrasting strips of inlay are especially attractive. Do not apply binding to top surface. The soundboard binding will cover this edge. Other more original patterns of marquetry are suitable if they remain muted.

Fig. 16

for the body be used for the face of the transom. Standard veneer is 1/28" thick. The binding, however, should be thicker, at least 1/16", because one of the functions of the binding is to absorb bangs and bumps that may damage the instrument. The easy solution to this mismatch in dimensions is to cut your own veneer to the thickness of the binding. If this is not desirable, then the standard 1/28" veneer should be glued to the transom right to the edge of the rib facets. A rabbet is then cut along the edges of the transom to the depth of the binding. Again, the Dremel Moto-Tool mounted in its router base does a nice job on this sort of cut. Fine-toothed saws and sharp chisels, along with a steady hand, also work to perfection. Inlays of contrasting wood, most notably ebony, between each pie-shaped segment of veneer make attractive transoms. Gluing and clamping the veneer segments to the transom poses no particular problem as there is sufficient room to use clamps and cauls. The bindings present a problem because of the lack of clamping surfaces. I have found that masking tape stretched over the binding being glued and then pressed on to the transom and ribs does the job.

Drill three 3/16" holes, at a 15° angle to the transom, in the location shown in Fig. 16. These holes are for the string pins. I use Luthiers Mercantile's Number Pi4m with a mother-of-pearl eye. The pins are tapered so it will be necessary to taper the hole to fit the pin by using a small rat-tail file as a reamer. Test the pin in each hole for a tight fit with about 1/4" of the pin extending above the surface of the transom being satisfactory.

The inside rib joints are now reinforced by gluing 1/2" wide linen tape over the seams. This is done by spreading glue along the joint line, embedding the tape in the wet glue, and applying more glue over the tape while pressing the tape flat against the joint. As an aside, I have left no stone unturned in a search for linen tape. I have made inquires from Texas to Maine and many places in between with no luck. I have settled upon linen cloth which I bias-cut on a 45° angle. I suppose that cotton tape would do as well but linen seems to be preferred by many old-time luthiers. Do not use tape made from synthetic material such as nylon. I have made many experimental joints and found that it does not glue-up properly. Back to the balalaika. We now need to surface the top edges of the body before fitting the soundboard. First, we must keep in mind that the soundboard is slightly convex to the extent that its center, near the bridge, is approximately 1/8" above the edges of the body. In surfacing the edges of the body try to allow for this slight taper so that the soundboard will have a good fit. *I have noticed that some balalaikas have a* tapered edge to the transom that conforms to the curvature of the soundboard. This is illustrated in Fig. 17 and perfectly acceptable.

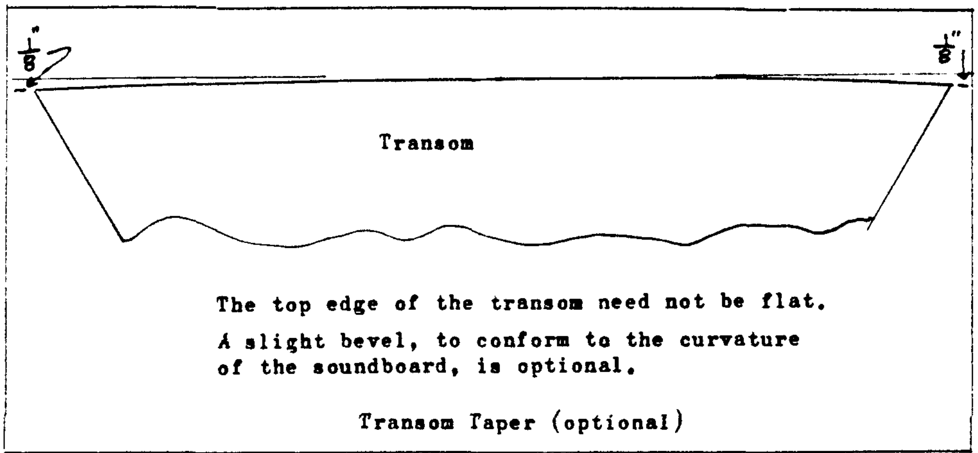


Fig. 17

A neat way of leveling the top edges of the body, as well as smoothing the face of the transom, is to glue four pieces of 120 grit sandpaper to a flat surface, preferably something akin to Formica, forming a 18 x 22" surface plate. The body is then placed upon this surface and rubbed until it is flat.

The inside surfaces of the body are now ready for final cleanup. The side linings, which were 1/2" square when originally installed, must now be reduced in size to a triangular shape. See Fig. 18.

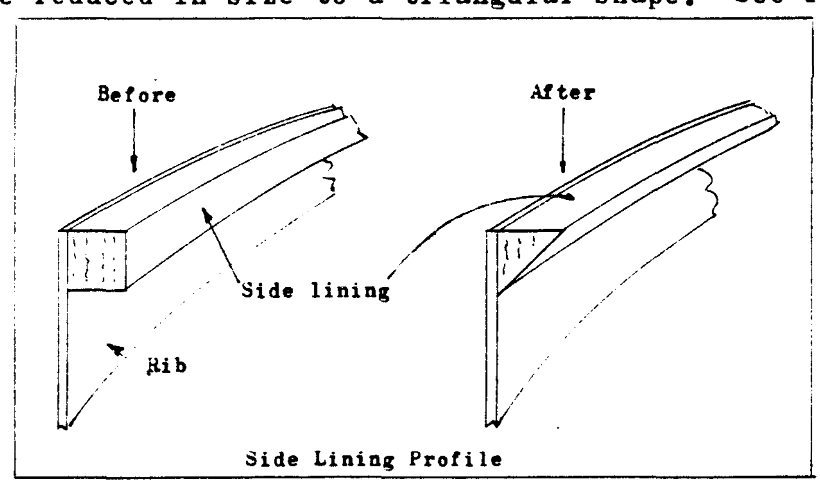
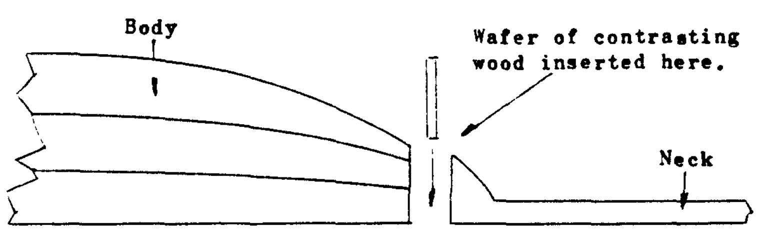


Fig. 18

The Dremel Moto-Tool with burr bits does a fast job of this. Linings along the ribs and transom are finished in the same fashion. Sand the inside surfaces of the body as if you were making a salad bowl. When finished, seal the inside surface with a thin coat of shellac. The object is to reduce the weight of the instrument by removing all superfluous wood and to produce a gracefully curved interior which should add to the acoustical quality of the balalaika. Further, you may feel a vibration or two when a luthier works on the instrument a century later and remarks about the fine quality of this "old" instrument.

We will now trim the excess stock from the end block. Carefully saw these rib ends flush with the block. Sand this end taking every precaution to assure that the edge geometry is true. Keep in mind that the neck is to mate with this surface and we want this alignment to be accurate. A nice decorative touch to this joint is to add a 1/8 to 1/4" wafer between the end block and the shoulder of the neck as illustrated in Fig. 19. If you do this make sure that you extend the length of the tenon on the neck to compensate for this additional depth.



Neck/body Joint Wafer

Fig. 19

* * *

The Head and Neck

The head and neck are made as an assembly and rough-shaped before being attached to the body. The function of the head (sometimes referred to as the "shovel" in Russian terminology) is to hold the tuning machines for the strings and that of the neck to hold the fingerboard with its frets. Again, it is important to select wood of proper strength (most important), grain orientation, figuration, and color. Common practice is to use the same species of wood used in the body. Curly maple, or other figured wood, does not make a strong neck because of its twisted grain. This can not be tolerated at the critical neck/head joint. However, there is no prohibition against using woods which complement the body such as a maple head and neck on a rosewood body. As usual, there are several choices of wood combinations best left up to the player. You will notice that the contour of the neck as it joins the head reveals a very small amount of wood stock holding the neck to the head. To insure rigidity and strength the entire neck is laminated with a thin strip of ebony approximately 1/8" thick. This sandwiched neck is shown in Fig. 20. The "V" joint for the head

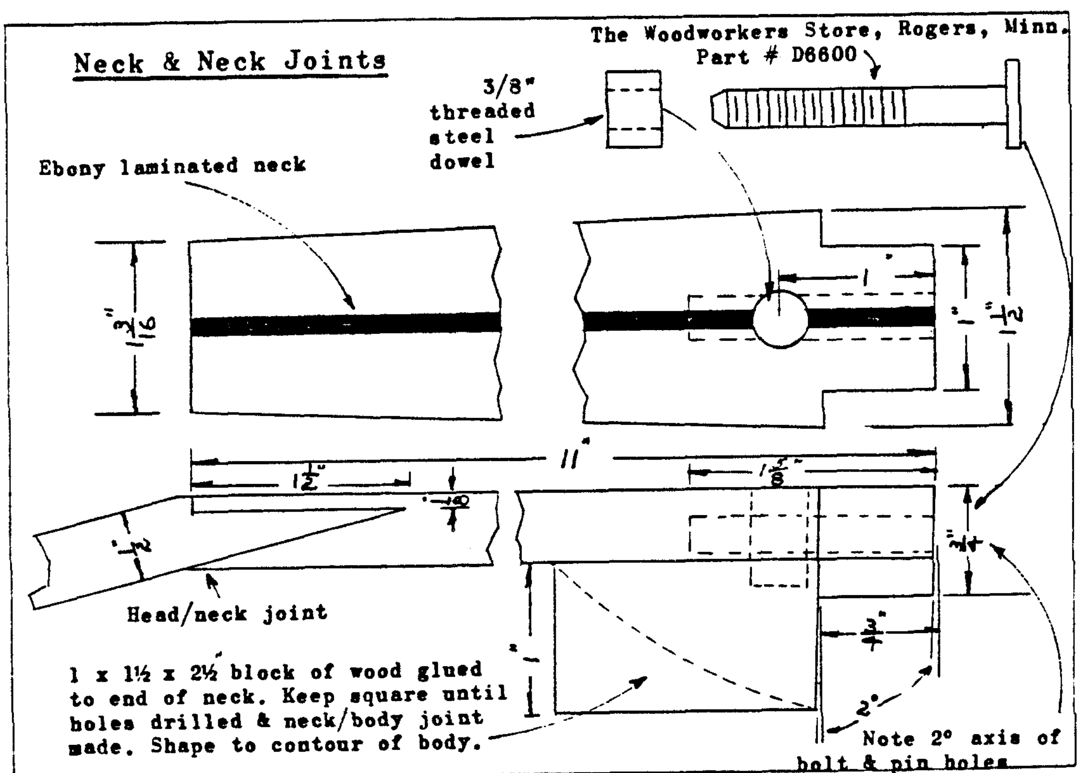


Fig. 20

and the neck is shown in Fig. 20. These two pieces are joined and glued in the "square" and then shaped to proper form after the joint is dry. This makes clamping a lot easier. A suggested head shape is shown in Fig. 21. The head drops back 15° from the neck.

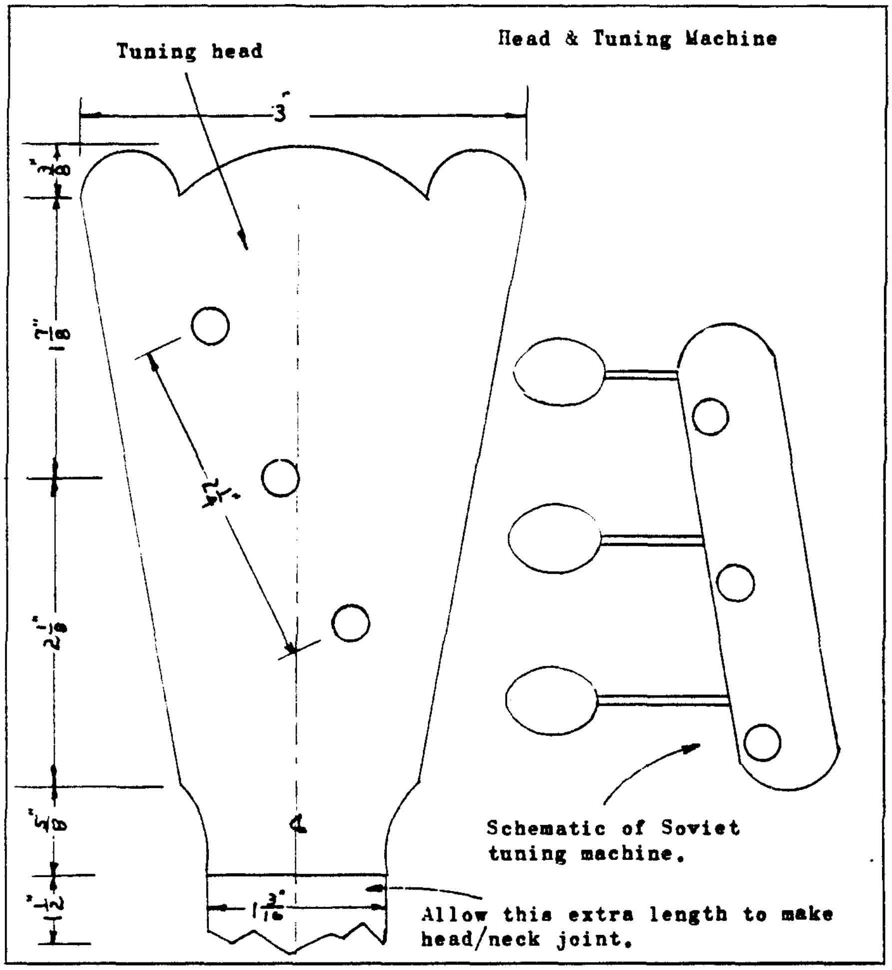


Fig. 21

Acquiring tuning machines for the balalaika has been a problem. The outline of a Soviet tuning machine is depicted in Fig. 21. As of this date, such machines are not available outside of the Soviet Union. I have written to the Lunacharski Musical Instrument Factory in Leningrad, where most of the balalaikas are made, and was advised that "spare parts" were not available. A source of a good quality tuning machine is suggested in the Appendix. Machines available from this supplier are not top-of-the-line and may have to be taken apart and reworked. This is not a reflection on the supplier but a recognition of the fact that these are probably the only machines available in the West. The Russian machines are completely recessed into the head and then covered with a metal plate. The machine from the source mentioned above is best mounted by recessing only the plate holding the string posts. Whatever type machine used, be careful that the recess does not weaken the head/neck joint. Other machines from instruments such as guitars, mandolins, etc., may be reworked and adapted to the balalaika. In so doing, do not change the basic character of the head. Keep the string posts in line with the string as it passes over the nut and keep the tuning knobs on the right side of the head.

The conventional joint for the neck to body interface on most musical instruments is some form of a tapered dovetail dado. The dado (channel) is cut into the end block and the dovetail cut in the shoulder block of the neck. This is an excellent joint. However, I use a form of this joint which is reinforced and in my judgement offers superior strength yet rather easy to machine. The heart of the joint, which is shown in Fig. 20, is a steel pin and threaded steel dowel stocked by *the Woodworkers Store, Rogers, Minnesota, under part number* D6600. This joint is made by first gluing to the neck a block of wood slightly larger than the profile of the shoulder block on the body. Keep this block square at this time as it will be easier to glue and hold clamps. Follow the dimensions in making the mortise and tenon for this joint which are specified in Fig. 20. Before permanently attaching the head and neck assembly to the body check to make sure that the top surface of the neck is 1/8" higher than the top of the shoulder block. This height offset is necessary to allow for the addition of the soundboard which, when installed, will be flush with the edge of the neck before the fretboard is installed. Also check to insure that the body drops 2° from the top surface of the neck; that the centerline of the body is in line with the centerline of the neck; and that the neck is not twisted out of alignment with the imaginary surface of the soundboard. An effective method for checking the proper alignment of the neck and body is to temporarily assemble the neck and body and place the neck on a flat surface such as a table. Measure the distance from the corners of the body to the table top and adjust the joint until these measurements are equal.

It is helpful to make a cardboard template like that shown in Fig. 22 to ascertain and accurately set the 2° drop of the head.

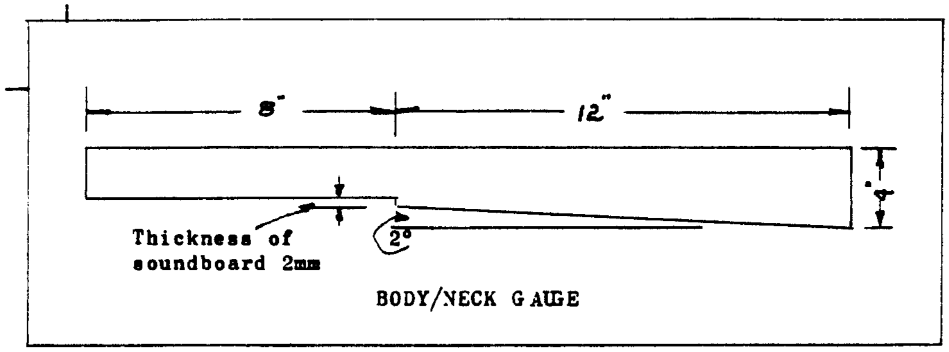


Fig. 22

Keep in mind that if this drop is much more that 2° then an inordinately high bridge will be required to set the proper action of the strings. On the other hand, if the angle is less than 2° then the fingerboard portion which extends over the soundboard (from the 17th to the 24th frets) may interfere with the free movement of the soundboard. When all this has been ascertained, glue the head and neck assembly to the body, insert the threaded dowel into the hole in the neck and thread the bolt into it thus clamping the joint permanently. The small wedge of the neck protruding above the shoulder can now be cut off.

* * *

The Soundboard

The soundboard is the heart and soul of the balalaika in spite of many old timers from the old country calling it the belly. The vibrating strings, transmitting through the bridge, cause the soundboard to oscillate over the air in the body (soundbox) creating the peculiar and wonderous tones of the balalaika. Selection of wood for the soundboard is an important decision. For those not intending to make many instruments it is best to purchase the wood from a reputable luthiers supply house. All soundboards are quarter-sawn as shown in Fig. 4. The highest quality of wood, which is referred to as "tone wood",is sawn from split billets. Specialists in tone woods spend a great deal of time searching out "saw logs" that show promise of cutting clear. The logs are cut into short lengths, from 18 to 24" generally, and are split, not sawn, through the center. The rare logs are those that split straight with nary a twist, knot, pitch pocket, etc. These pieces are then split again into smaller pieces and eventually sawn into rough soundboards. When air-dried they become the top quality instrument tops. Sitka spruce (Pieca sitchensis (Bong.) Carr.), Engelmann spruce (Picea engelmannii Parry ex Engelm.) and western redcedar (Thuja plicata Donn ex D. Don) are all excellent tone woods for soundboards and readily available. For the prima balalaika we will need a piece 3/16 x 8 x 24". A two-piece classical guitar top will generally fit the bill and make two balalaika soundboards. One piece is cut in half and joined to make one piece 16 x 24" with the grain running in the 12" direction. See Fig. 23 for details. Scrape and sand it to perfection without cutting it to shape. If it is cut to size first, leaving the final finishing to a later time, there is a tendancy to cut the edges too low. Always sand with a sandpaper block lest small indulations in the wood appear. They will not be noticeable until after the soundboard is finished and reflected light emphasizes them. We are looking for a soundboard that will end up about 2 mm thick.

Place the soundboard on top of the body and then trace the body's outline on the soundboard. In doing this be watchful that the center seam lines up with the center of the body at both the end block and transom. Cut the soundboard to this shape. Hold it aside while we

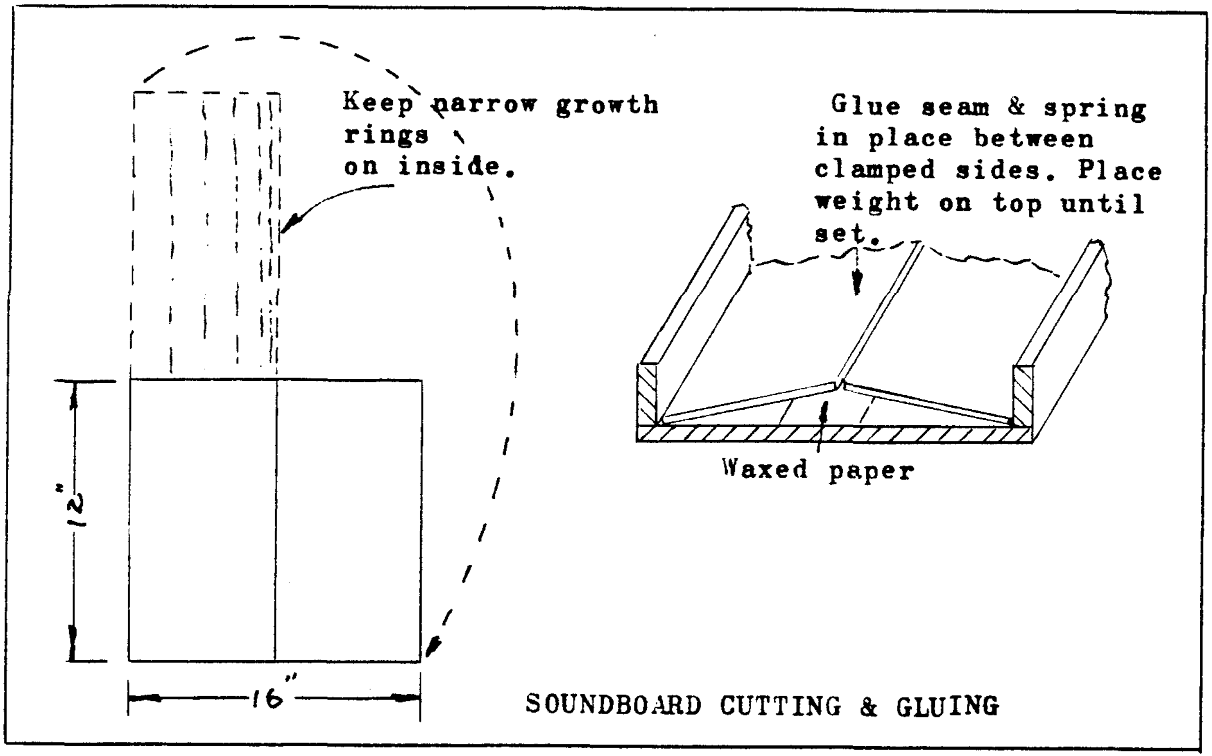

Keep narrow growth rings on inside.
Glue seam & spring in place between clamped sides. Place weight on top until set.
Waxed paper
12"
16"
SOUNDBOARD CUTTING & GLUING

Fig. 23

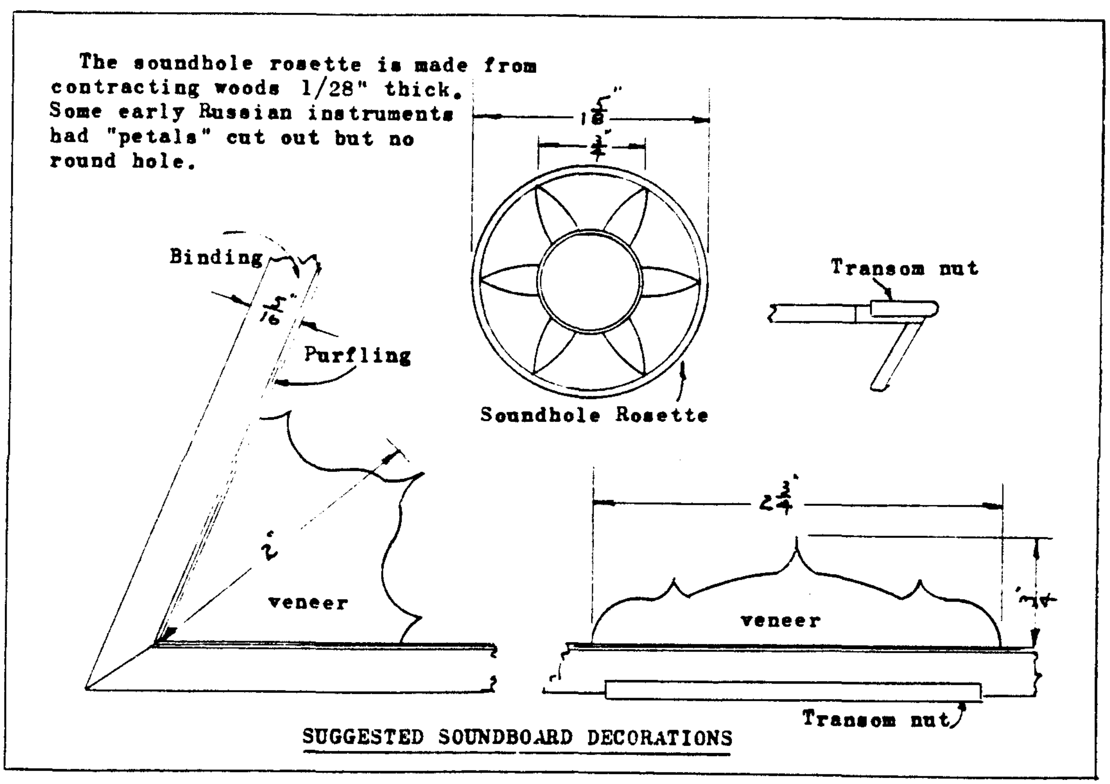

The soundhole rosette is made from contracting woods 1/28" thick. Some early Russian instruments had "petals" cut out but no round hole.
Binding
Purfling
veneer
Soundhole Rosette
Transom nut
veneer
Transom nut
SUGGESTED SOUNDBOARD DECORATIONS

Fig. 24

ponder what to do with it. We must plan the strut (brace) system beneath the soundboard; what sort of soundhole decoration (rosette) to use; the scheme for edge binding and purfling; the corner decorations; and, the decoration near the transom nut. These suggested decorative aspects are illustrated in Fig. 24. These patterns are typical, not absolute. For example, the soundholes of some Russian balalaikas were decorated as lodge windows. Other soundholes are merely concentric rings of contrasting woods. I strongly urge that builders design their own and let such a pattern become their "signature" on the instrument. The suggested strut design and placement are shown in Figs. 25 and 26.

We will discuss the details of the soundboard decorations first. Drill the 3/4" soundhole now. This is best done with a cylindrical hole saw or a circle cutter mounted in a drill press. The best insurance for getting a sharp hole is to sandwich the soundboard between two other pieces of wood and drill all three together. (I drill my soundholes with a 7/8" Forstner pattern bit and use 1/16" walnut as an edge rim thus bringing the finished hole to 3/4".) The soundhole decoration should be made of 1/28" veneer. Always cover the open-grain edge of the soundhole with a thin piece of wood. This is easily bent on a hot soldering iron and glued in place by using a tapered wood plug as a clamp. The plug is used to push the ring of wood evenly against the sides of the hole. As a matter of fact, the tool looks like a large sized version of a jewelers ring gauge.

Make a paper pattern of the soundhole design to be used. Cut the wood parts and glue these small "inlays" to the paper with a thin coat of rubber cement. When completed, lay this assembly over the center of the soundhole and scribe its outline thereon. Chisel out the soundboard so that the decoration sets flush with its surface and then glue it in place. Remove the paper which has held the part in place and level the surface of the decoration with that of the soundboard. The corner decorations and that near the transom nut are done the same way with the exception that using paper to hold the inlay is not needed because such ornamentation is usually one piece. The soundboard decorations we have just discussed can be the thickness of the soundboard. If this procedure is followed, it is

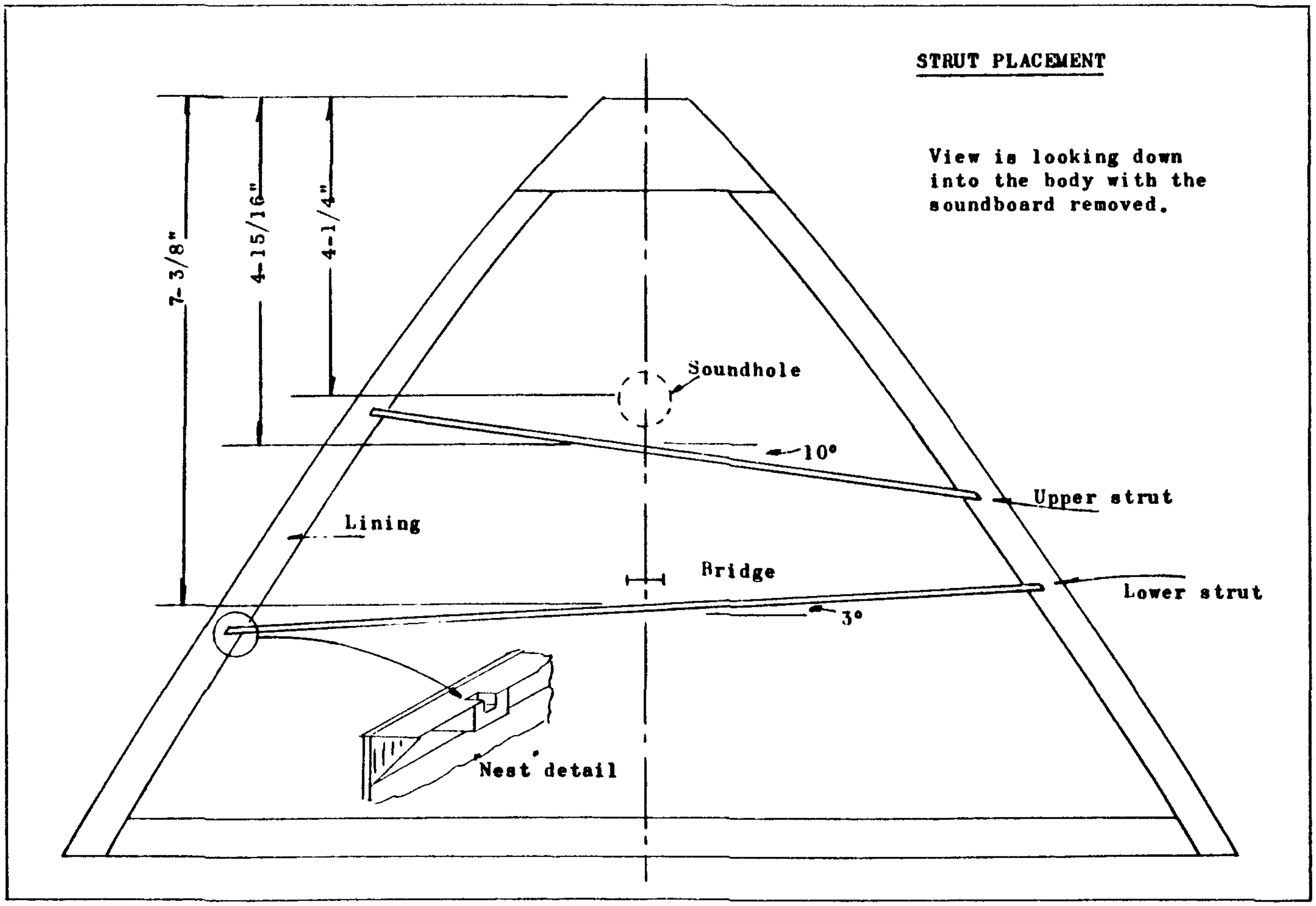

STRUT PLACEMENT
View is looking down
into the body with the
soundboard removed.
7-3/8"
4-15/16"
4-1/4"
Soundhole
10°
Upper strut
Lining
Bridge
Lower strut
3°
Nest detail

Fig. 25

wise to glue a piece of linen on the underside of the decoration to reinforce the inlay seams.

Strut design and placement is a critical part of any musical instrument with a soundboard such as the balalaika, guitar, lute, etc. It can make or break the instrument as an effective producer of sound. There are exceptionally talented luthiers who have done a lot of painstaking experimental work on struts. It would not be possible to describe the ideal sizing and placement of struts in the balalaika because I am not sure that it is known in the West. As an "average" scheme I would like to fall back on a description of struts in a Soviet publication, by N. Prokopenko, who writes;

> "Two softwood braces are attached beneath the top for better flexibility. The braces divide the top into three parts. In profile the braces are wedged shaped. The highest point of each brace is in the center; they become thinner toward the ends. The ends of the braces are attached to the "nests", which are slots cut into the softwood kerfing which is attached to the upper edge of the ribs to afford a greater gluing surface for the top."[3]

So we will work on a two-strut system placed in pockets in the side linings will full confidence that the Russian technique will produce a fine quality tonal output. Fortunately, Prokopenko provided a sketch of his two-strut system but he did not supply dimensions. Fig. 25 is a very close approximation of his layout. Fig. 26 provides

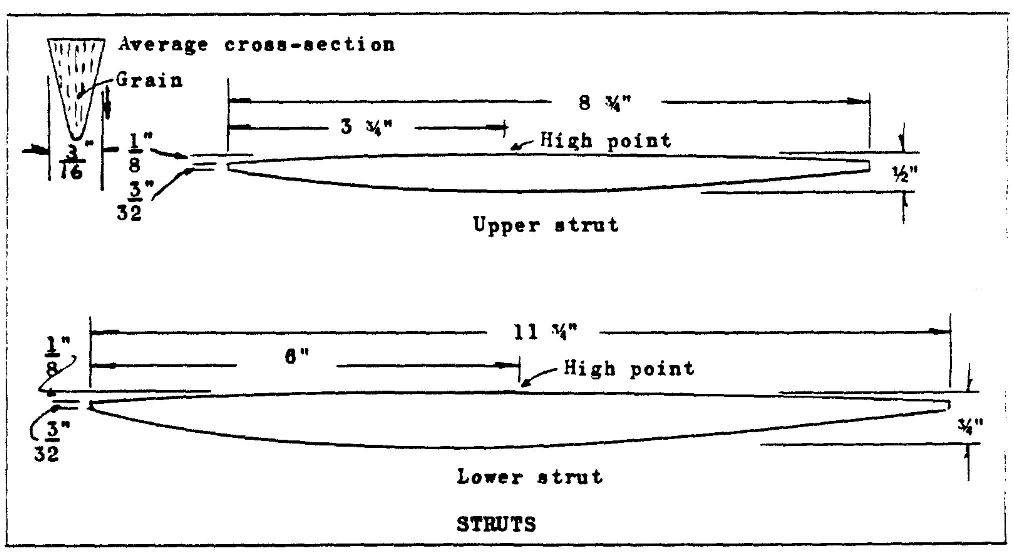


Fig. 26

[3]Prokopenko, N. The Construction, Preservation and Repair of Folk Musical Instruments., Moscow, Izdatel'stro, 1977

the approximate dimensions for the struts. Luthiers with other ideas on this will probably follow their own ideas, some of which may call for slanting the struts at different angles to emphasize the bass notes; not securing the ends of the struts in "nests" in the lining (probably the better way for the lower strut); stressing a variety of different shapes; etc. This work is highly endorsed and encouraged and will lead, hopefully, to the more perfect instrument. In the meantime let's let "Prokopenko struts" be the standard from which we can measure performance.

The top surface of the struts is arched to give the soundboard a corresponding curvature. Notice in Fig. 26 that the high point on the top of the strut is not the center of the strut. (Be careful of Prokopenko's wording...he means what I am saying). The high point of the strut is where it crosses the centerline of the instrument. It is essential that the struts be cut with proper grain orientation. They should be quarter-sawn with the grain running parallel along the flat surface rather than at right angles to it as is the case of the soundboard. This is the best cut to give strength to this part and allow minimum bending when pressure is applied to the top from the bridge.

We previously cut the side linings to a triangular shape. Go back now and glue small triangular blocks on the lining where the ends of the struts will nest. This is shown in Fig. 25. Fair the corners of these blocks into the linings by removing the straight edges and corners except for the top surface. Cut a small pocket approximately 3/32" deep and the width of the strut into this built-up section of the lining to accomodate the ends of the struts. Place the struts into these pockets and make sure that they fit well. Don't glue them in place at this time. At each end of the struts, just in from the lining, wrap a piece of masking tape in a way that the sticky side will be on the outside. Now carefully center the soundboard over the body, press down on the top, and lift the top off with the struts adhered thereto. Precisely mark the position of the struts on the underside of the soundboard. Lift the struts off, remove the tape, and glue them in place permanently. Clamping the struts to the top may present a problem because the struts are curved and the object is to spring the soundboard to this arc. One effective way is to use large, squeeze-type, paper clips at the ends of the struts. Dry clamp the struts in place first and then inspect the prospective joint to make sure that the soundboard is going to adhere to the complete surface of the strut. This is an important gluing operation because there is considerable stress on this joint, the failure of which will lead to a distastefully sounding instrument. Place a maker's label inside the body below the soundhole. Conventionally, the label includes the maker's name, location and date.

We are now ready to glue the top to the body. This is another awkward clamping job. The top could be taped to the body but in many cases removal of the tape also removes slivers of wood from the soft soundboard. I have been tempted to make an elaborate press for this operation but am holding off until I find junk parts to make one. Obtain a large supply of rubber bands of a size that will stretch around the body of the instrument. Spread glue along the body linings and place the soundboard on being careful that the strut ends fit into their pockets and that the soundboard lines up with the centerline. Stretch as many rubber bands as possible around the body and place under the bands, as they go over the edges, small blocks of softwood approximately 1/8 x 1/2 x 1/2". These blocks transfer pressure to the edge. In addition to, or substitute for, the rubber bands a flat cloth tape (like a shoe lace) can be wrapped around the body and top thus binding the edges. In spots where the top is being stubborn and is not mating with the body,strapping tape can be used but make sure that the soundboard is covered with paper so that the tape does not touch it.

Binding and purfling the top is next. The total width of the binding and purfling should not exceed 5/16". We must not destroy the integrity of the soundboard/body glue joint by cutting away too much of the soundboard edge. Make sure that the surfaces of the ribs near the soundboard and the top surface of the transom are in their final dimensions. Sanding and scraping these surfaces after the binding has been installed will narrow the binding and result in an uneven look. After these precautions have been noted, cut a rabbet along the top edges of the soundboard a hair narrower than the combined width of the binding and purfling. This can be done with a purfling cutter, a tool similar to a marking gauge except that it has sharp knives instead of a pointed scriber. This rabbet can also be cut with a small machine router with proper guide attachments. The binding will probably not spring into place along the curved edges of the top without hot bending. Because we are bending along the narrow edge of the binding it is difficult to hold straight on the hot iron. This problem can be alleviated by making a sandwich of two or three pieces of binding and then bending them all at once. After the binding has been bent to the proper shape, glue the purfling to the inside edge of the binding and clamp with masking tape. Remove the tape when the glue has set and glue this assembly to the top edges. First fit the side bindings to the end near the neck, then miter the end near the transom. The rubber band clamping procedure is used to clamp the binding to the top. It is best to glue one side binding on at a time and then bind the transom end last. Sand and scrape the binding and purfling flat with the top of the soundboard and along the edge of the body. The edges should be rounded slightly.

In line with the transom nut decoration, mortise the binding to accept the transom nut. This nut is best made of ebony and glued in place with a few drops of cyanoacrylate glue (Elmers Wonder Bond Plus). Refer to Fig. 24 for details.

* * *

The Fingerboard

The twenty-four frets of the prima balalaika provide a musical range of two full octaves. Each octave is divided into twelve equal parts called semitones or half-steps. Fret spacing for this equal tempered tone range is computed in the traditional way. Divide the length of the string (nut to bridge) by 17.817. The quotient becomes the distance from the nut to the first fret. This distance is then subtracted from the length of the string and the difference is then divided by 17.817. This quotient then becomes the distance from the nut to the second fret. Continue with these calculations until the spacing for all frets is completed. A sample computation for a 17.0" string length is provided below:

*** Fret spacing.... 17" string ***

A	B	C	A	B	C	A	B	C
1	0.953	0.954	9	6.886	6.892	17	10.626	10.632
2	1.853	1.855	10	7.453	7.459	18	10.983	10.990
3	2.702	2.705	11	7.989	7.995	19	11.321	11.327
4	3.504	3.507	12	8.494	8.500	20	11.639	11.645
5	4.261	4.264	13	8.971	8.977	21	11.940	11.946
6	4.975	4.979	14	9.421	9.427	22	12.223	12.230
7	5.649	5.654	15	9.846	9.852	23	12.491	12.497
8	6.286	6.291	16	10.247	10.254	24	12.744	12.750

A = Fret number

B = Nut to fret distance (in inches) using constant 17.835

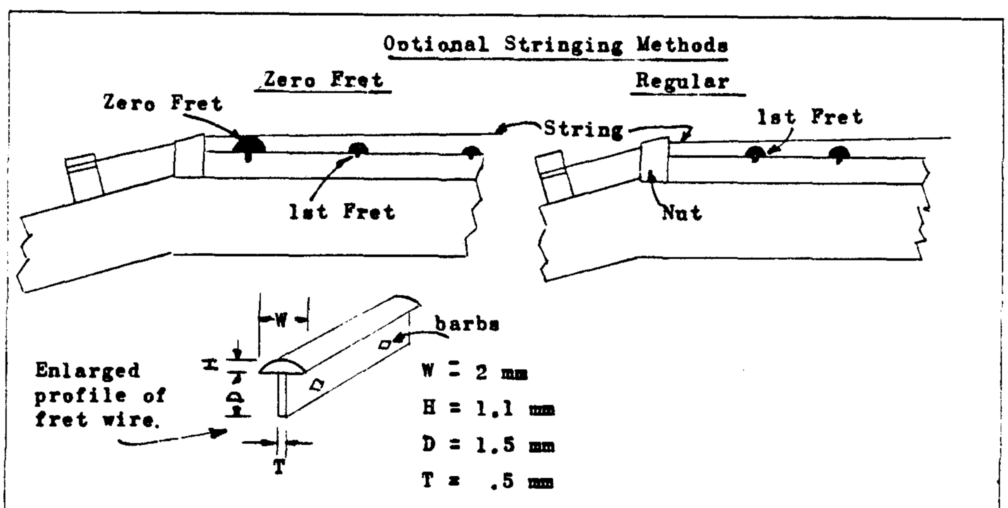
C = " " " " " " " " 17.817

Notice that the 12th fret falls half way between the nut and the bridge. Some luthiers prefer to use a constant of 17.835 rather than 17.817. Tonal purity (acceptable tones at all frets) for both sets of calculations is obtained by minute changes in the position of the bridge. The above table lists both sets of computations for comparison with the 17.817 calculations being preferred. In reality, one cannot cut the fret slots much better than within one one-hundredths of an inch anyway!

A program for computing fret spacings on a personal computer, a Radio Shack TRS-80 in this case, is as follows;

```
10  REM spacing
30  C = 0
40  K = 17.817
45  L = (insert length of string)
50  FOR I = 1 to 24
60  X = L/K
65  C = C+X
70  PRINT USING "##.###";C
80  L = L-X
90  NEXT I
100 END
```

The fretboard (or fingerboard) is cut from a piece of ebony 3/16 x 1 1/2 x 13". As we discussed earlier, there are other suitable woods for this application but ebony remains the one of high choice. Make sure that it is absolutely flat and free of twist. Sand and scrape the top surface to a high gloss. Do not taper the outer edges of the fretboard at this time. Keep it square. It is best to make a fret scale from aluminum with a tapered edge. Mark the fret locations on the tapered edge of the aluminum with a sharp knife-like tool. It is a good idea to use a scale which is graduated in 1/50ths of an inch such as the Dietzgen 1590. The aluminum scale is then used to mark the fretboard by scratching a fine line then scribing it across the width of the fretboard with a try-square. Before we mark the fretboard we need to discuss the "zero" fret. Prokopenko calls this a "registering" fret. Normally, the length of a string is measured from the nut to the bridge. Some luthiers place a "zero" fret... which is a fret of a larger size than the rest of the frets...in the location where the nut is normally placed. The nut is then placed 1/4"



Zero Fret

Fig. 27

or so behind the zero fret and lower than this fret so that the string rests on the fret as well as the nut. This assures a very low string action. In this case the string length is measured from the zero fret to the bridge. This is no gimmick and I have seen such frets on some exceptionaly fine instruments. An illustration of this, as well as the conventional nut placement, is shown in Fig. 27.

Fret wire comes in a variety of sizes. An enlarged cross-section of fretwire suitable for the prima balalaika is shown in Fig. 27. The wire comes in soft and hard types with the hard type being preferred. A fretsaw that has a blade width the exact size of the tang of the fretwire is used to cut the slots for the frets. The slots should be slightly deeper than the tang but not so deep as to cut beyond half the thickness of the fretboard. An improvised miter box, as well as a small wooden try-square, can be fabricated to guide the saw. After the slots have been cut, the fretboard can now be cut to its final shape. This is shown in Fig.28.

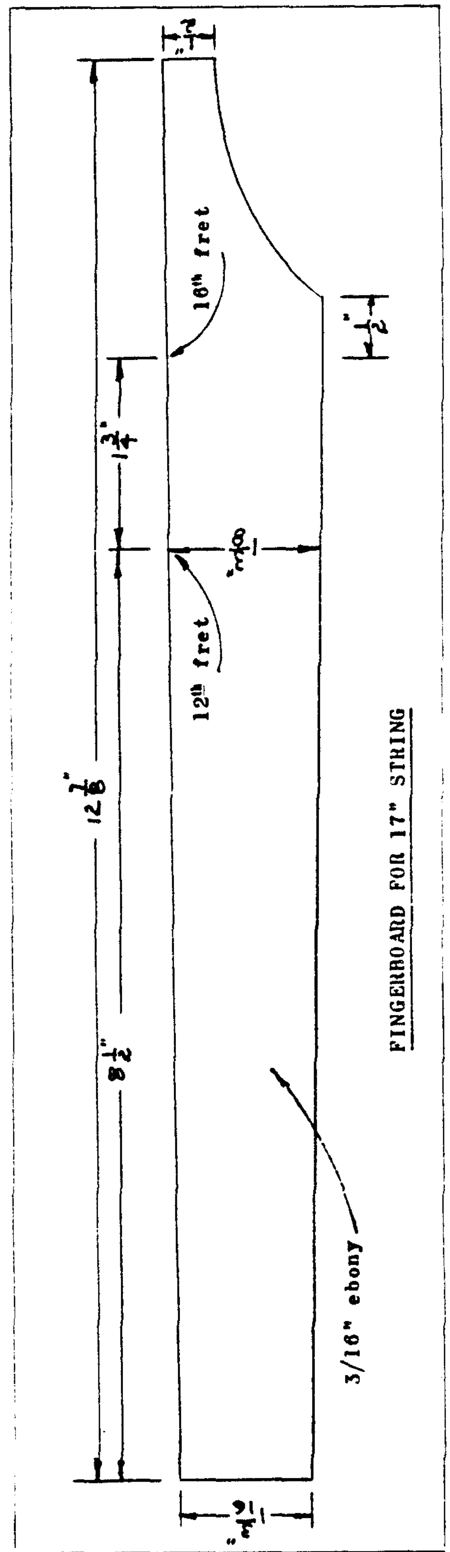


Fig. 28

Mother-of-pearl dots, 6mm, are inlaid in the center of the spaces above the 2nd, 5th, 7th, 10th, 12th, and 14th frets and 5mm dots above the 17th, and 19th frets. A special mark can be placed above the 12th fret to identify it as an octave fret. Drill holes for these dots deep enough to permit them to remain slightly above the surface of the fretboard. Attach them with epoxy cement. When dry, sand them flush with the surface. Sand and scrape the board to its final smoothness as this will be the last chance before the frets get in the way. Install only the 17th to the 24th frets at this time. I like to cut the wire 1/4" longer than needed and then cut the ends off after the fret is in place. Start the fret in the slot with a hammer and drive it home with a wooden block insulating the hammer from the fret. File the ends of the frets flush with the edge of the fretboard and inspect for burrs. The ends of the frets should be rounded so that they take the same contour as the fret in its longitudinal direction. Do not round off any edges of the fretboard at this time. This precaution primarily concerns the fretboard from the 16th to the 24th fret. The reason is that we want the fingerguard to fit tightly around the fingerboard at this location. Now place the fretboard on the neck and hold the balalaika up to a light. Looking into the light, sight down the prospective fingerboard/neck joint to determine if it is well mated. Take special note of the fingerboard as it extends over the soundboard. Make a pencil mark on the soundboard in the position of the 20th fret. Glue a 1/4 x 1/8" strip of spruce or other softwood on the soundboard from the 16th to the 20th fret so that the strip is centered under the extended length of the fretboard. When the glue is dry, taper this strip from 0" at the 16th fret to approximately 1/16" at the 20th fret. Place the fingerboard on the neck and keep shaving the strip until it rests flat under the fingerboard. The strip is placed in this position to strengthen the extended portion of the fretboard which is in "free air" over the soundboard. The strip is not placed under the whole length because it will then rest on a vibrating portion of the soundboard. The 20th fret is the position that marks the end of the shoulder block. Glue the fretboard to the neck, being careful to place the 16th fret at the neck/body joint. Caution; if you are using an oily wood such as ebony or rosewood, wash the surface to be glued with Bestine before gluing. This will remove any oily film that may be on the surface. Bestine is a solvent used to reduce rubber cement and is sold in office supply stores. Be sure to observe the fume and flammability precautions on the label.

The head and neck are now ready for the final shaping, sanding and melding in with the body. Install the ebony nut at the edge of the fingerboard as shown in Fig. 20. Use cyanoacrylate adhesive for this. Trim the block at the neck/body joint to gracefully conform to the contour of the balalaika shown in Fig. 3. Complete the fretting of the fingerboard. Place a cradle-like block under the fingerboard so that the fret hammer shock is properly absorbed. Shape the underside of the neck to the profile shown in Fig.29. Round off the edges of the fingerboard and the frets so that your fingers make a smooth transition over the frets.

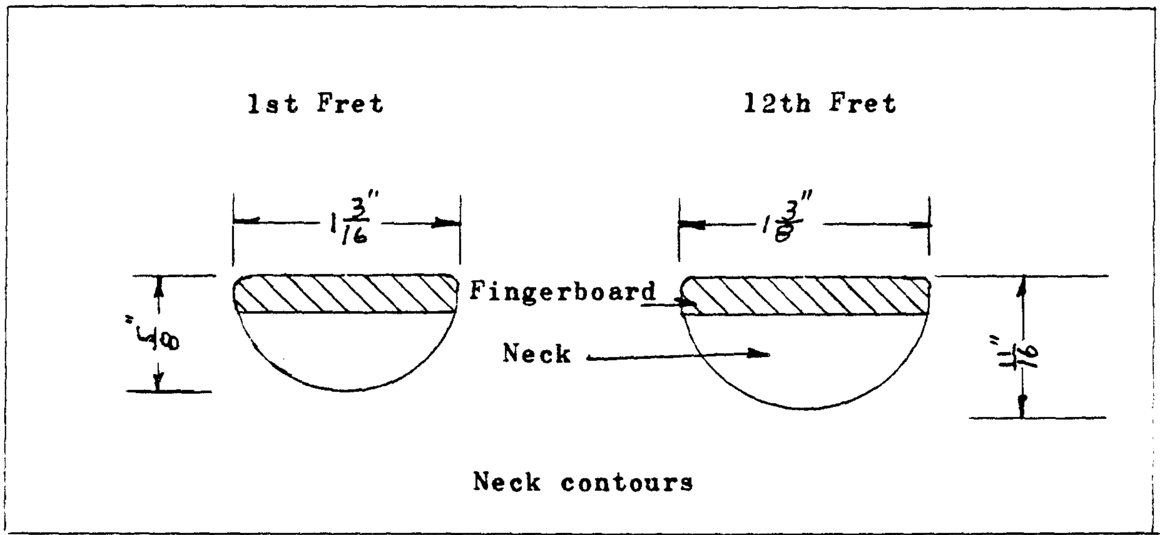


Fig. 29

* * *

The Fingerguard

Fabrication and installation of the fingerguard, or pancer, is one of the last items to work on. There are many designs for the shape of this part. Its prime function is to prevent the soft soundboard wood from being scratched and worn by the fingers while strumming the instrument. Specifications for this part are as follows; (1) it should be made from a hard, tight-grained wood; (2) the top edge should be flush with the top edge of the fingerboard; (3) it should not touch the soundboard except along the edges; and (4) it should cover a wider segment of the left side of the instrument because of the downward sweep of the strumming hand. A suggested shape for the fingerguard is supplied in Fig. 30 along with the details for attaching it to the top. The fingerguard is first cut to rough size and care-

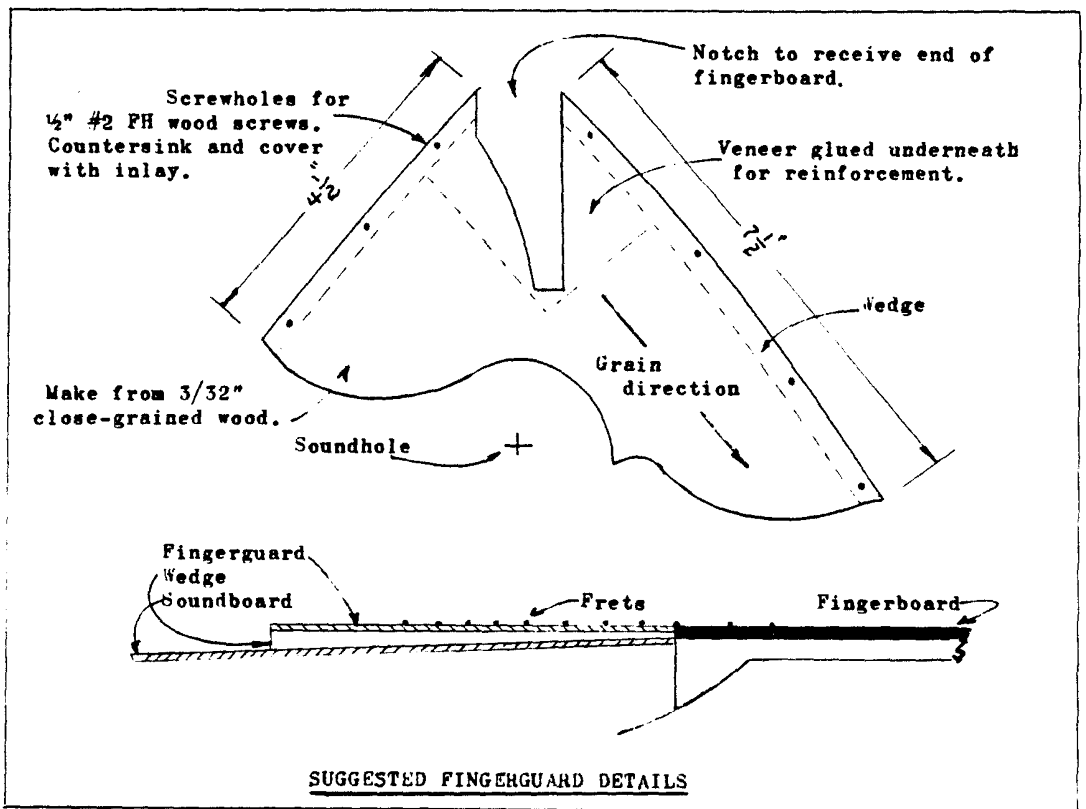
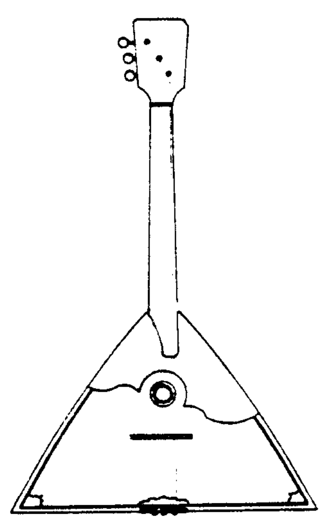


Fig. 30

fully fitted to the contour of the fingerboard. The wedges, made of the same species of wood as the fingerguard, are cut and glued to the underside of the fingerguard. Notice that the fingerguard comes to a rather sharp point where it terminates with the neck. Make sure that the wedges fit well at this point as it will reinforce the edge. The portion of the fingerguard that outlines the shape of the fingerboard should be reinforced by gluing a piece of veneer to the underside running at right angles to the grain of the fingerguard. Drill holes for the screws in the fingerguard in positions noted in Fig. 30 and attach to the body. It is not necessary to glue this part in place. This makes it easier to replace a worn fingerguard as well as facilitating removal of the soundboard if repairs are required. Sand and scrape the edges of the guard until they fit the contour of the body. (Some balalaika makers glue thin strips of felt beneath the fingerguard to dampen oscillations that may be transmitted from the soundboard by contact or induction. It is possible, that at certain frequencies, the fingerguard can be induced to vibrate and cause tonal problems. If the fingerguard acts "noisy" it is best to insulate it from the fingerboard. This is done by applying a thin strip of adhesive-backed felt along the edge of the fingerboard as it touches the fingerguard. The slot in the fingerboard will have to be trimmed to accomodate this and then reinstalled tightly against the felt.) Remove the fingerguard from the instrument as this will not be finished.

* * *



Bridge and Tuning

The instrument should now be strung and tested in its white (unfinished) form. The fingerguard can be reinstalled for this purpose but do not forget to remove it when we have completed the string tests. We now need a bridge. Many balalaika players prefer the solid ebony bridge although a bridge made of hard maple with an ebony inlay top is an effective one. Shape and dimensions of a bridge are shown in Fig. 31. The height of the bridge is determined

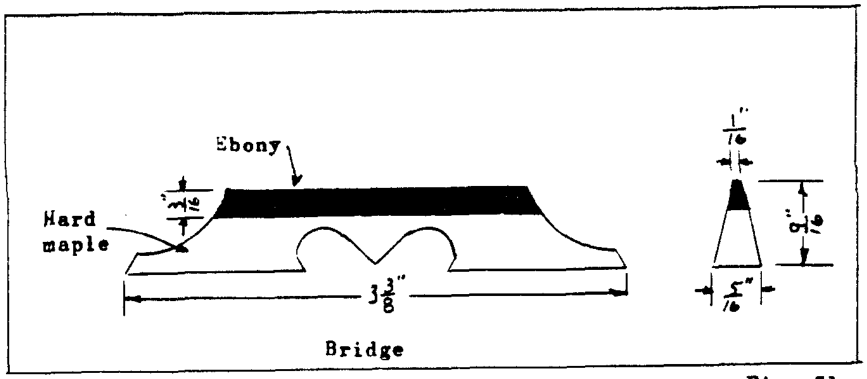


Fig. 31

by the position of the strings over the 16th fret. This distance should be approximately 4 mm which will result in a bridge about 1/2" tall. The final height and positioning of the bridge is best determined by the ultimate user of the instrument. This is a highly personal preference and proper positioning is very much a function of the player's style. Place the bridge 17" from the nut. Under the bridge place a piece of 120 grit sandpaper with the sand portion up. Rub the bottom of the bridge over the sandpaper until it conforms to the contour of the soundboard. String the instrument with strings sized per the data in Table I. Peg the loop end of the string to the transom with the string pegs and lightly tap them in place. Thread the other ends through the string post on the tuning machine (which we have reinstalled) and tighten the strings by a counter-clockwise turn of the keys. When the strings are reasonably tight, file slight indentations on the top of the nut and the bridge permitting the two outside (1 & 3) strings to lie in a straight position along the fingerboard 1/8" from the edge. The middle string should pass over the soundhole in its center. Gradually tighten the strings until they are nearly up to the proper pitch (see Fig. 1) and test the strings for "buzzing". String problems are most apt to show up when the strings are slightly loose. The strings should run in small indentations (not slots) over the nut and bridge and be slightly higher (1/16") than the first fret. Plucking the strings should produce a sharp and clear note. If a rasping noise (buzzing) is detected, the string may be oscillating in the notch at either the nut or bridge. Verify this by applying sideward pressure with a finger to the outward side of the nut/bridge. This may correct the problem. Placing a small wad of paper in the notch, under the string, may also improve the situation, which means that corrective action to file the notch is required. After the open strings have been tested, it is necessary to check the fret clearances. Pressing the first fret should bring the string down on the fret without exerting an uncomfortable amount of pressure. Plucking the fretted string should produce a clear note without buzzing. If buzzing is detected it is probably because the string is hitting the next higher fret, in this case the second fret. The second fret should be filed lower until the buzzing is corrected. This problem is most likely to occur at the first five frets but all frets should be checked. Final polishing and deburring of the frets should now be completed. A system for electrically checking fret clearances is shown in Fig. 32. Remove the strings, bridge, tuning machine and fingerguard and prepare the balalaika for finishing.

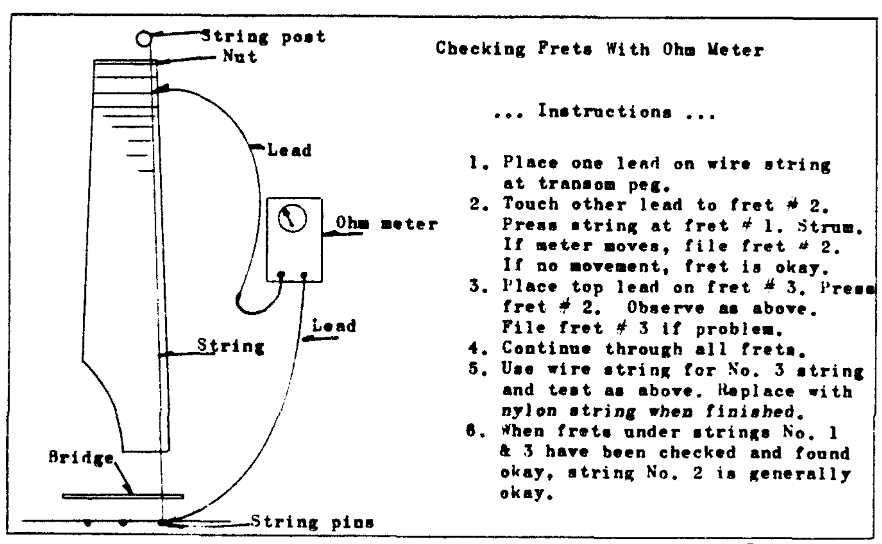


Fig. 32

* * *

Finishing

Most balalaika players want their instruments to have a high-gloss finish. As a matter of fact, I doubt if you will find one who would prefer a dull one! More on this later, especially as it refers to the top. There are many types of modern finishing material available on the market today. You can chose wax, lacquer, oil varnish, spirit varnish, French polish, etc. It would be impossible to cover all of these options in this book. The preferred finish seems to be French polish. This finish is made from orange shellac and other ingredients. It is applied with a rubbing pad and is extremely tricky. Because it is so sophisticated, and requires years of practice to get the hang of working it, I will eliminate it as a practical finish. This finishing material can be purchased in prepared mixtures and those with time and willingness to experiment should use it. It does produce a superior finish. A stringed instrument such as the guitar and balalaika is normally finished with a spirit varnish as opposed to an oil varnish. The oil varnish is recommended for the violin. Most factory made instruments like the guitar are finished with lacquer. I recommend that the balalaika be finished with a spirit varnish. Before proceeding in this direction I do wish to suggest that the body be varnished but that the soundboard be lacquered. This may result is a mis-match in sheen between the body and the soundboard but the idea is to keep the finishing material used on the top as light as possible from a thickness perspective. A heavy varnish build-up on a small instrument like the prima balalaika most probably will have an adverse affect on the resonance of the instrument. Behlen sanding sealer 101-0803 and their clear gloss lacquer B101-0800, in spray cans, are very good items to use for small applications.

We will continue assuming that you will wish to finish the balalaika completely with the spirit varnish. Some musicians prefer to keep the neck in an unfinished state. In my judgement, the majority of them have no preference, so we shall finish ours. The fingerboard, bridge, and fingerguard are not finished. If ebony is used for the fingerboard, white or gray streaks may appear on its surface.

There are products on the market such as Ebonholzbeize made to stain the ebony a uniform color. Remove all dust from the instrument and mask the fingerboard to prevent the finish from straying on it. With a very damp cloth, go over the instrument to remove stubborn particles of dust. This will raise the grain ever so slightly. Now sand it with 600 grit silicon sandpaper. Dust it again.

Woods such as spruce and hard maple do not need wood fillers because the grain structure is tight. Woods such as mahogany and rosewood do need a filler to even out the surface caused by the uneven grain structure. There are many manufacturers producing paste wood filler. Most of the fillers have to be mixed with a stain compatible with the ingredients of the filler. It is best to follow manufacturers' instructions for the use of the product rather than provide specific data here.

The soundboard is not generally stained but remains in its natural color. If the instrument is to be stained it is essential that a stain that can be used under shellac and spirit varnish be applied. Again, follow manufacturers' instructions. Do not use an oil stain under a shellac or spirit varnish.

After the instrument has been stained, or if it is not to be stained, apply a thin coat of white shellac. After four or more hours drying, lightly sand it with 600 grit sandpaper. Apply a second coat and sand as before. Then apply two or three coats of spirit varnish. Prior to applying the last coat of varnish carefully rub down the finish with 600 grit sandpaper moistened with oil. This is best done after the varnish has cured for several weeks. Apply the finish coat. Again, after several weeks of curing, the final polish can be given. This is done by rubbing the instrument with a paste made of oil and a fine grade of powdered pumice stone and a soft felt pad. The pumice will level all blemishes such as runs, dust marks, etc. Care should be taken to avoid cutting too deeply into the finish...especially at the edges. The final polish is with powdered rottenstone applied the same way as was the pumice stone. Try practicing this polishing on test panels before working on the balalaika. Reinstall the tuning machine and fingerguard. Cover the screw holes in the fingerguard with mother-of-pearl dots and sand flush. String up the instrument as it is completed!

* * *

Table I

Balalaika Measurements

	Prima	Secunda	Alto	Bass	Contrabass
Nut to bridge	17-17 3/4	18 3/4 - 19 3/4	19 3/4 - 21	29 1/2 - 30 3/4	43 1/2 - 46 1/2
Instrument length	26 1/2 - 27	29 1/4 - 30 1/4	31 1/2 - 32 1/4	44 1/4 - 45 3/4	63 - 67
Body length	10 3/4 - 11 1/2	12 1/4 - 12 3/4	12 3/4 - 14	19 3/4 - 21	31 - 32
Body width along base	16 1/2 - 17 1/4	19 - 19 3/4	20 - 20 1/2	27 1/2 - 29	41 3/4 - 49 1/4
Body depth at transom	4 1/4 - 4 3/4	5 - 5 3/4	5 3/4 - 6 1/4	7 3/4 - 8 3/4	13 1/4 - 14 1/4
Neck width at nut	1 - 1 1/4	1 1/4 - 1 1/2	1 1/4 - 1 1/2	1 1/4 - 1 3/4	1 1/2 - 1 3/4
Neck width at 12th fret	1 1/4 - 1 1/2	1 1/4 - 1 1/2	1 1/4 - 1 1/2	1 1/2 - 1 3/4	1 3/4 - 2
Thickness of neck at #1 fret	5/8	25/32	25/32	1	1 1/2
Thickness of neck #12 fret	25/32	15/16	15/16	1 1/2	2
Length of head	4 1/2	5 3/4	6	6 3/4	7 1/4
Width of head	3	3 1/4	3 1/2	4	4 3/4
Soundhole diameter	3/4	7/8	7/8	1 1/4	2
Number of ribs	5 - 7	6 - 7	6 - 7	7 - 8	9
Thickness of soundboard	2 mm	2.5 mm	2.5 mm	3 mm	4.5 mm
Number of frets	19 - 24	15	15	18	16 - 17
Fret and body meet at...	16th	15th	15th	15th	13th
Diameter of fretwire	2 mm	2.5 mm	2.5 mm	3 mm	5 mm
Strings* # 1	.011 plain	.020 wound	.025 wound	.031 wound	.074 wound
# 2	.040 nylon	.024 wound	.033 wound	.041 wound	.099 wound
# 3	.040 nylon	.024 wound	.033 wound	.057 wound	.116 wound

* String data courtesy of: Joseph Valentich, 105 Hemlock Lane, Monroeville, PA 15146

Except where noted, all dimensions are in inches.

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Wood Handbook, U. S. Department of Agriculture, Superintendant of Documents, U. S. Government Printing Office, Washington, D.C.

Information on Balalaika Music

Balalaika and Domra Association Of America
c/o Carlen & Carlen, Ltd.
14 Perimeter Park Dr. Suite 111-A
Atlanta, Georgia 30341

Information on Lutherie

Guild of American Luthiers
8222 South Park Ave.
Tacoma, Washington 98408

Where to get materials.

I have listed below the addresses of a few companies which stock material for musical instrument makers. Unfortunately, I cannot list all of them but this is a representative list in case you have no place to turn.

Luthiers supplies:

The Luthiers Mercantile
P.O. Box 774
412 Moore Lane
Healdsburg, CA 95448

International Luthiers Supply
P.O. Box 15444
1415 South 70th East Ave.
Tulsa, OK 74112

Elderly Instruments
P.O. Box 1795
541 East Grand River
East Lansing, MI 48823

International Violin Co.,Ltd.
4026 West Belvedere Ave.
Baltimore, MD 21215

Strings, tuning machines and fretwire for balalaikas:

Joseph Valentich
105 Hemlock Lane
Monroeville, PA 15146

Soundboards: (Special cuts if required)

Santa Fe Spruce Co.
129 Kearney Ave.
Santa Fe, New Mexico 87501
(Engelmann spruce)

Fred Mayer
Fred Mayer
Alaska Music Spruce
9006 Firndale ve
Juneau, AK 99801 9901
(Sitka & other spruce)

Finishing materials:

Trendlines
170 Commercial St.
Malden, Mass. 02148

Hardware & tools:

The Woodworkers Store
21801 Industrial Blvd.
Rogers, Minn. 55374

Leichtung
4944 Commerce Parkway
Cleveland, Ohio 44128

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