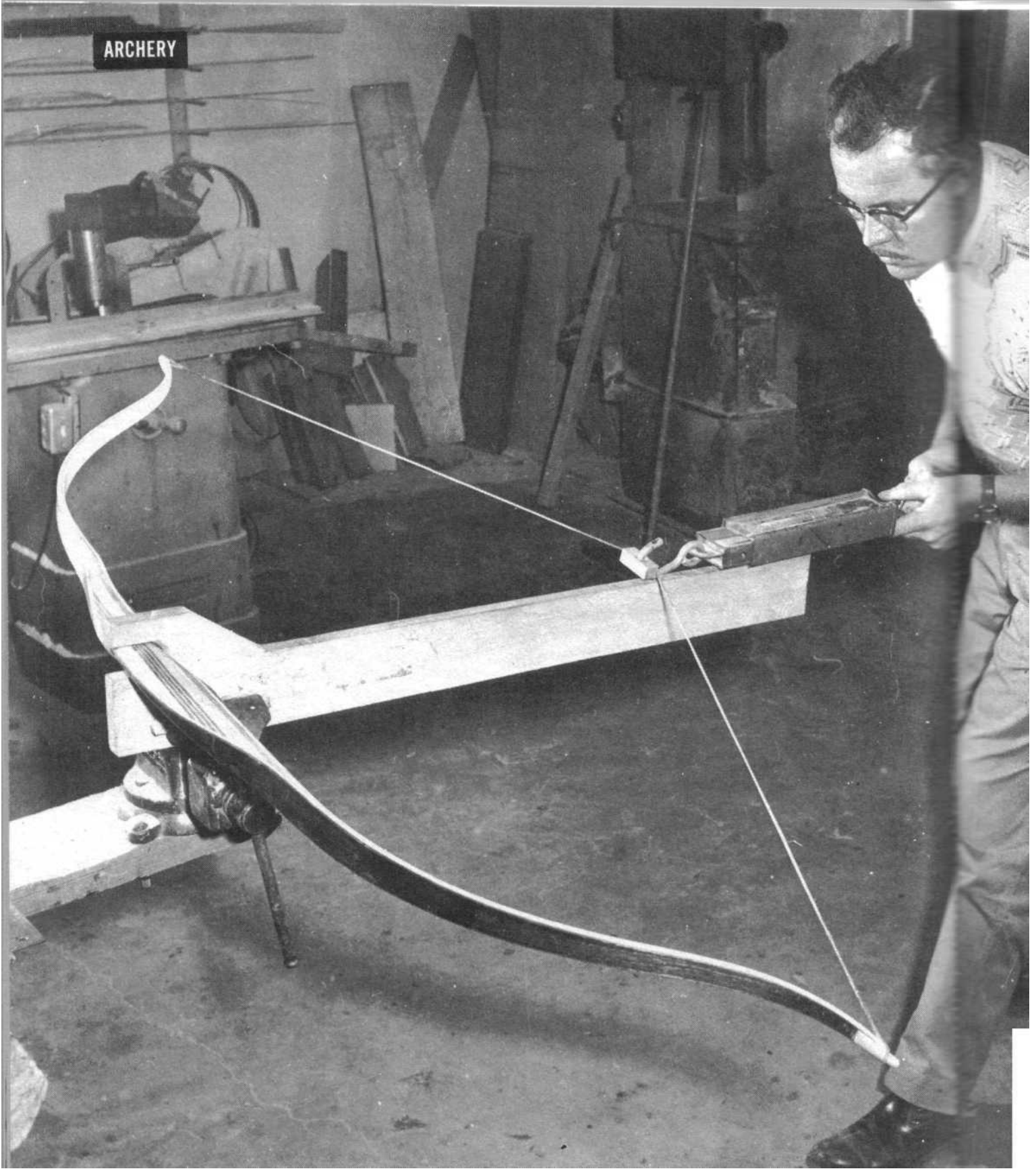


Tom Jennings of S. & J. Archery checks the weight oi a finished laminated recurve bow with spring scale and graduated base board. Glass and core lamination thicknesses largely determine weight of each bow.

How to Make a Recurve Bow

The knowledge gained through the experience of making your own bow makes this more than just a prideful accomplishment.

SOONER or later the enthusiastic archer gets a yen to make his own bow. His reasons may be economical or experimental, but whatever they are, his skill as a craftsman should be equal to his enthusiasm or his venture into bow-making could prove dismal and costly. It's one thing to get a slat or stave of lemonwood and whittle out a simple bow that will perform to a fair degree of satisfaction, but the beginner who attempts to make a laminated recurve bow is tackling the most difficult project in the critical field of bow-making. There are so many variables and pitfalls in the construction of a laminated bow that to turn out a successful job on the first try is an achievement in itself. Yet, the thrill of accomplishment and the knowledge gained through this experience make it a worthwhile venture, even if it takes two tries to succeed.

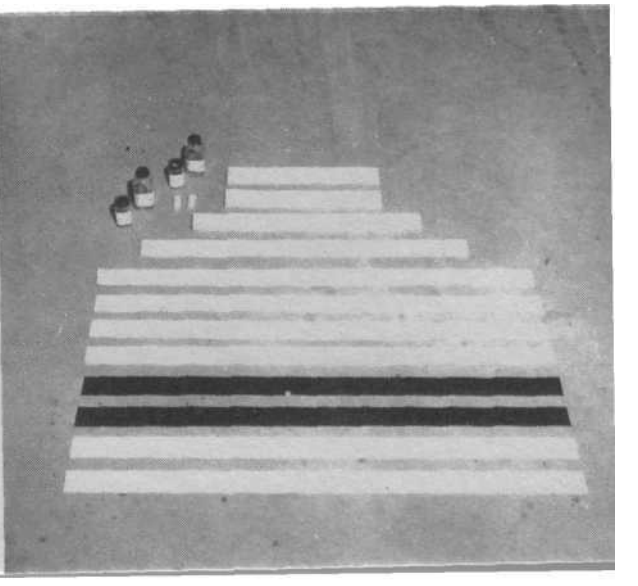
Today's modern bow is made up of laminations of wood and Fiberglas, the wood serving as a neutral core or spacer between two laminations of Fiberglas. Actually it is the Fiberglas that does the work of the bow, carrying 88 percent of the load while the wood core carries only 12 percent. As you increase the spacing between the two Fiberglas laminations by using a thicker core, you automatically increase the strength of the bow by the square. Thus, if you double the thickness of the core, you increase the weight of the bow four times. Since the thickness of the laminations is measured in thousandths of an jnch, it is easy to see how just a few thousandths of an inch more thickness in the core can make a bow too heavy for your use.

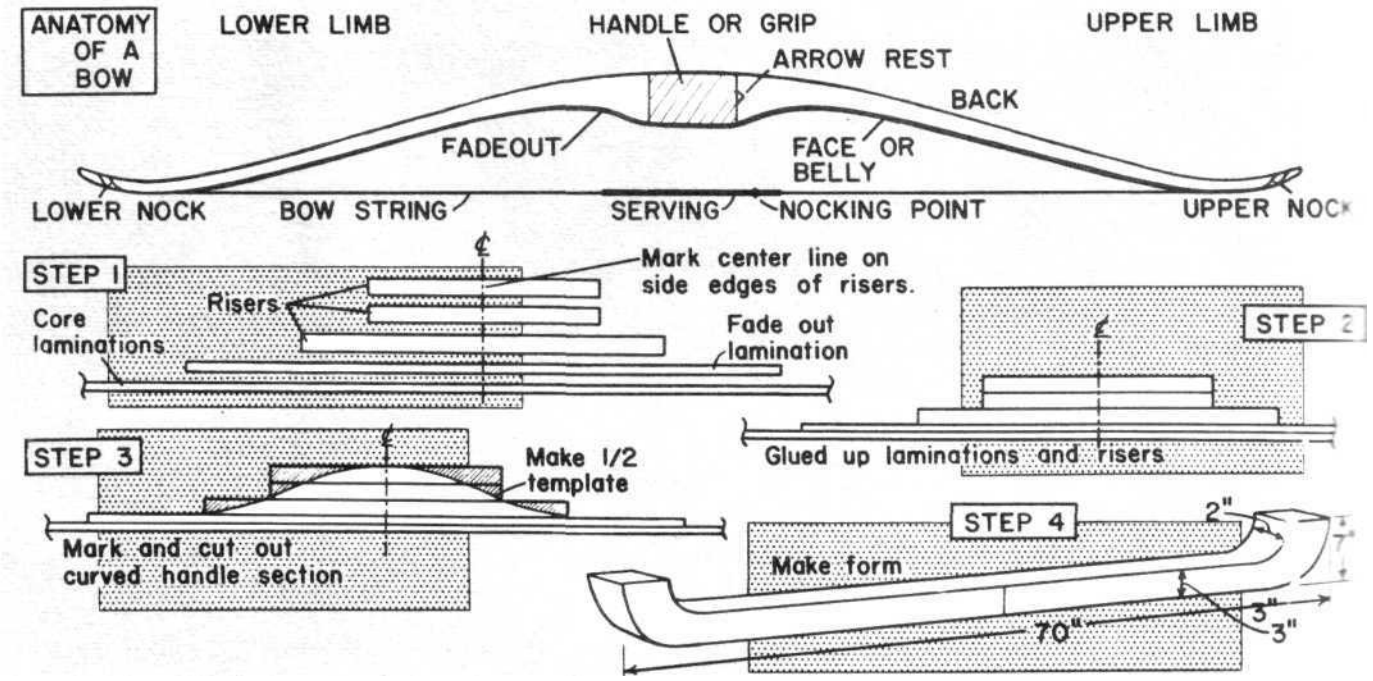
There are several woods that are suitable for bow-making, among them hickory, Osage orange, yew and lemonwood. However, maple is the most common core wood used in glass-faced and backed bows because it is a consistently hard dense wood, very straight-grained, and readily available in good clear grades. The beginner is wise to use maple rather than some of the other woods which are tricky to handle because of knots and twisty grain patterns.

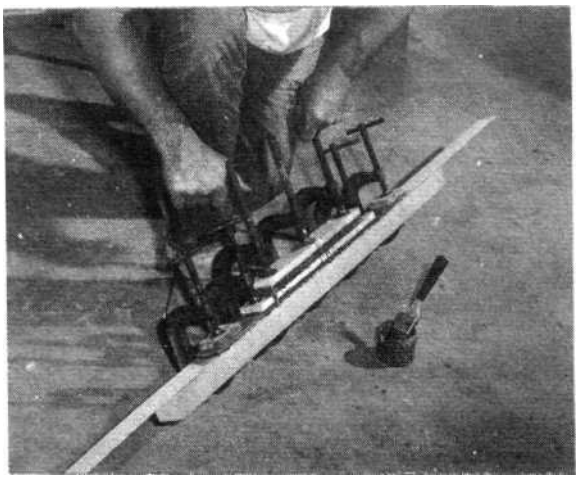
To make things easier for the beginner, there is a bow kit available that con-

Core laminations are cut from same block of hard maple in order to insure matched limbs.

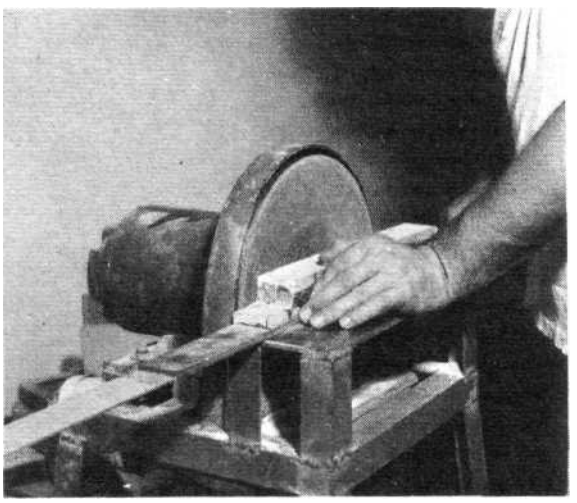
Kit contains all materials needed for making laminated recurve bow in weight desired.







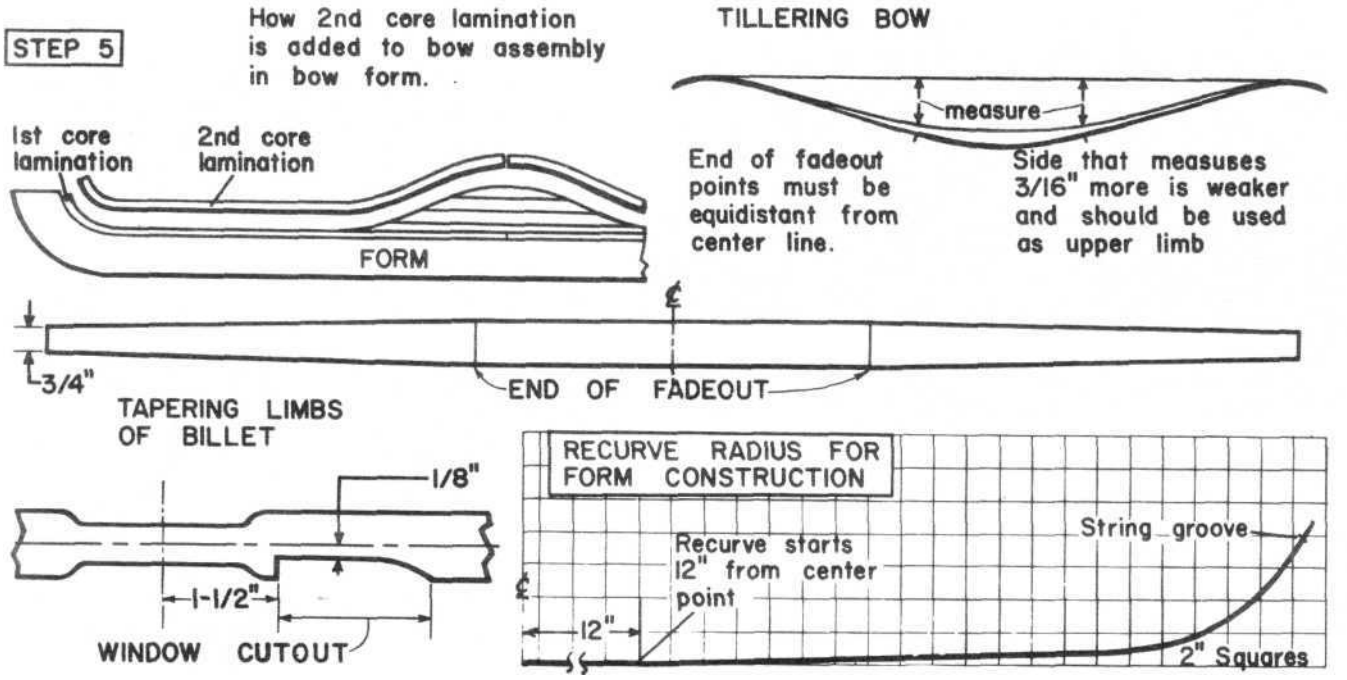
Glue up risen and base core laminations; damp unit to straight bar to insure good glue lines.



After glue has dried, clean off edges of bow assembly and lay out curve it is to be cut down to.

tains all the necessary woods, Fiberglas and glues to make a custom, 5-foot 6-inch recurve bow. The wood sections and Fiberglas strips are of uniform thickness and the wood is cut from matched sections of hard maple wood of the finest quality. The kit, which sells for $24.95, is put out by S. & J. Archery, 10945 Burbank Blvd., North Hollywood, Calif., makers of custom Smithwick bows, and provides all the necessary materials to make a custom bow, as shown in the photos in this chapter.

Before making a bow, however, it is a good idea to acquaint yourself with the anatomy of a bow and the terms used to denote its various parts. As shown in the diagram on this page, the bow, when held vertically, has an upper and lower limb, each extending from the central handle or grip. The smooth ledge cut into the upper part of the grip on the side where the arrow will travel is called the arrow rest or plate. The side of the bow facing away from the archer is called the back, while the side facing the archer is called the belly or face. The belly portions on either end of the handle that taper inward toward the limbs are called the fadeouts or dips. At the end of each limb is a string groove which is called the nock, known respectively as the upper and lower nock. The bowstring has a reinforced center section called the serving; the little ball of string located opposite the arrow plate and used

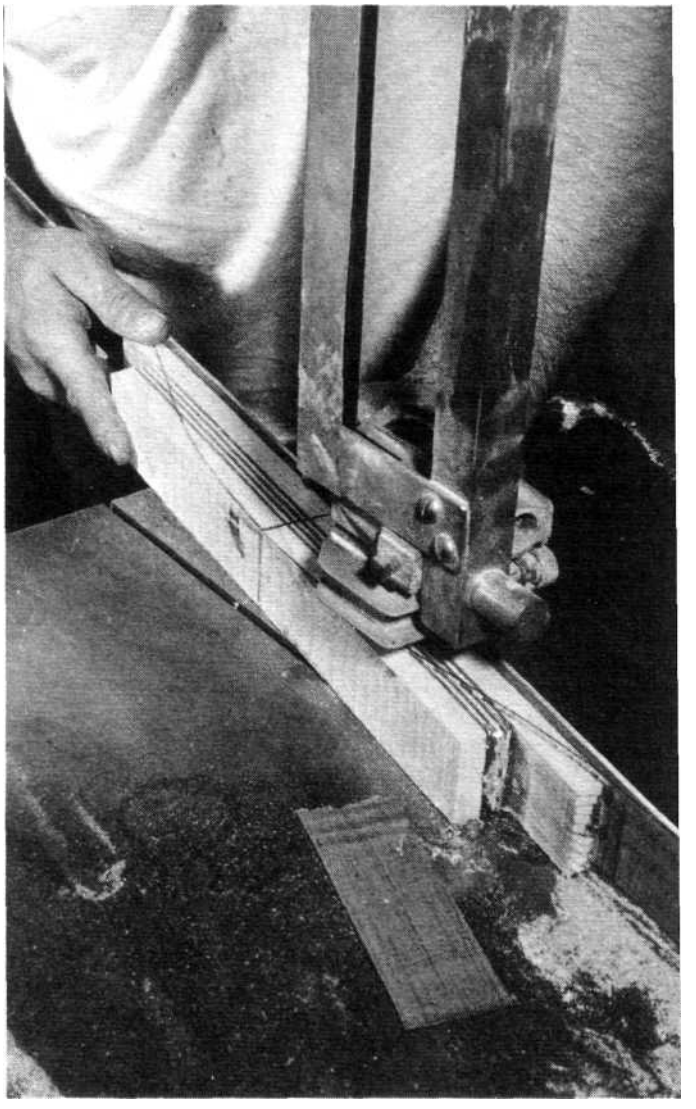


to take the guesswork out of nocking the arrow is called the nocking point.

To make the custom bow shown in the photos, you will need the following materials, all of which are supplied in the bow kit mentioned above, and can be purchased as a unit or as separate items:

2 strips Fiberglas (1¾x36) .....for belly of bow
2 strips Fiberglas (1¾x36) .....for back of bow
4 lengths Canadian hard maple lamination (1¾x36) .....for core of bow
1 length maple lamination (1¾x28x¼) ....base lamination to be faded into core
1 maple block (1¾x18x½) .... for riser, or center section of bow
2 maple blocks (1¾x14x½) .....for top of riser
2 maple blocks (1½x¾x¼) ....for string groove reinforcement
1 bottle M-74 plastic glue ....for cementing glass to wood
1 bottle C-31 plastic hardener .....used on glass only
1 bottle Urac No. 185 .....for cementing wood to wood
1 bottle Urac hardener ....for all wood-to-wood surfaces

The thicknesses of the glass and core laminations determine to a large extent the weight of the finished bow and should be carefully selected with that in mind. It is practically impossible to draw up a formula that will give you the correct thicknesses for any specific weight bow because of the many other factors that can affect your bow weight. For instance, your bow weight will be affected also by the length of the bow, the design and amount of recurve, its width and taper, and the type wood used in the core. A long center-section riser



Use a bond saw or jig saw to cut out this curve, taking care not to cut into fade-out lamination.

will shorten the working limbs and increase the weight of the bow, while a shorter grip section will allow you longer working limbs and thus lighten the bow. It takes very little to add or subtract 10 pounds from the weight of a bow and, for this reason, anyone building a laminated bow of his own design can never be sure what weight it will be until he can actually test the bow.

Bow makers make many bows and do a considerable amount of experimenting before they establish a standard of operation for any one bow, and because this has been done with the Smithwick Custom Bow, it is possible to order a bow kit for the weight bow you wish to make. The kit will then have laminations of the correct thickness to give you the right basis from which to start. Even then, the success of your ultimate weight goal will depend on how skillfully you shape and taper the limbs. Once the billet or roughed-out bow is completed, you cannot add any more weight to it. You can only take weight off.

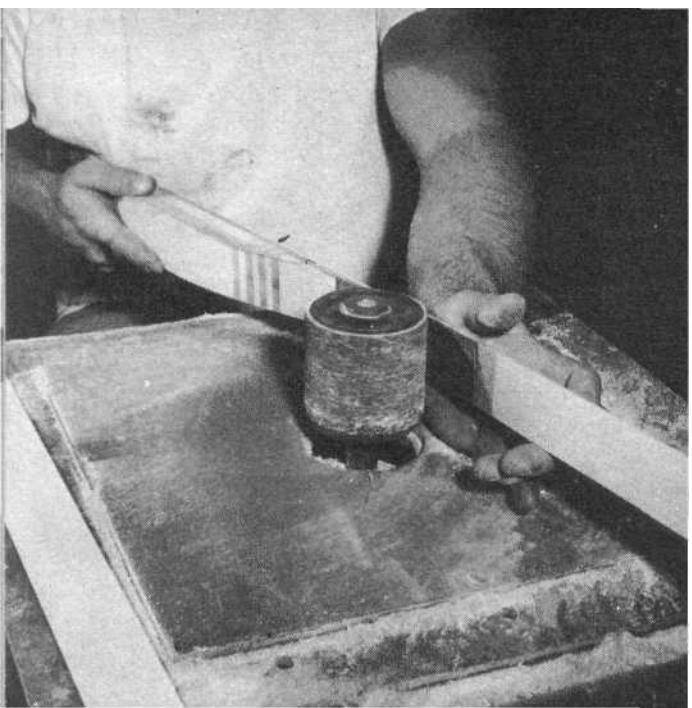
As a general rule, the following lamination thickness specifications will, if applied to the bow design shown, produce a bow that will correspond closely to the desired weight you wish to achieve: for a 50 lb. bow: .175-inch core, .050-inch back glass and .060-inch belly glass; for a 40 lb. bow: .175-inch core, .042-inch back glass and .048-inch belly glass; for a 25-30 lb. bow: .160-inch core, .040-inch back glass and .045-inch belly glass.

The lighter 25-30 lb. bow is usually a lady's bow and requires additional changes in the tapering of the billet to bring the weight down without reducing the thickness of the limbs too much. This is because there is a ratio between the thickness and the width of the limbs where the bow gives the best performance.

With all your materials laid out, you are now ready for the first step in making your bow. This step consists of gluing the riser blocks to the core laminations. However, before applying any glue, it is a good idea to assemble the component parts dry and familiarize yourself with the position each piece occupies so that there will be no mistakes when the glue is applied. Once the glue has been applied, you must join and clamp the pieces together without delay in order to get a perfect bond. To make sure that the pieces are positioned properly, mark the center line across the side edge of each piece. When all units are assembled, the center lines should coincide to form a straight line across the edge of the risers.

In this first step, you glue together only the three riser blocks, the fade-out lamination, and one pair of core laminations. The pair of core laminatioris are laid end to end under the riser blocks to form a continuous 6-foot long core as shown in the diagram. This core comes in two sections; in order to assure perfectly matched upper and lower limbs, two 36-inch lengths of core lamination are cut from the same 36-

Taper fadeout into base lamination. Extreme care must be taken to avoid gouging base lamination.



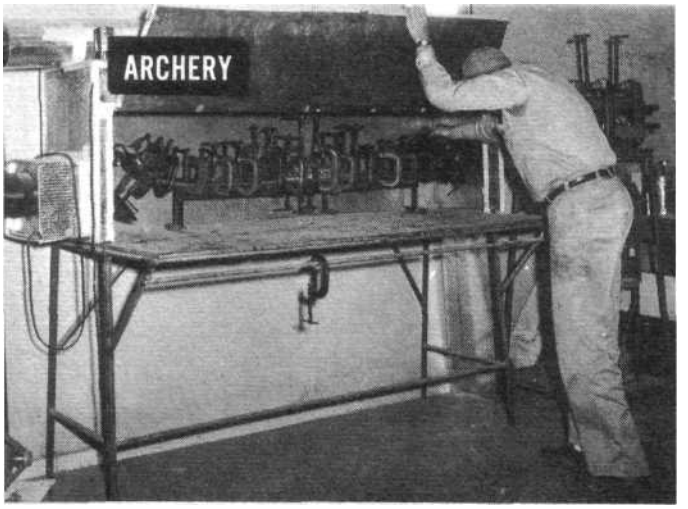
End of fadeout blends into base lamination. When done right, there won't be any detectable ridge.

Glue second pair of core laminations, Fiberglas facings to bow assembly and secure to bow form.

inch long block of hard maple. The two pieces, coming from the same section of wood, are as closely matched in grain and wood characteristics as is possible to achieve. This is true also of the second pair of core laminations which are glued to the assembly in another operation.

The wood portions can be cemented together with any good wood glue, such as urea-base glues or Elmer's Glue. The glue supplied with the kit is Urac No. 185, which is used with a Urac hardener. Apply the glue evenly with a 1-1/2-in. brush to both surfaces being joined and clamp the assembly firmly between blocks and a straight bar of wood or metal. The straight bar is important for insuring good glue lines. Use enough clamps to distribute the pressure evenly along the entire area being

Inner-tube strips or tape can be used to secure assembly to bow form to establish recurve shape.



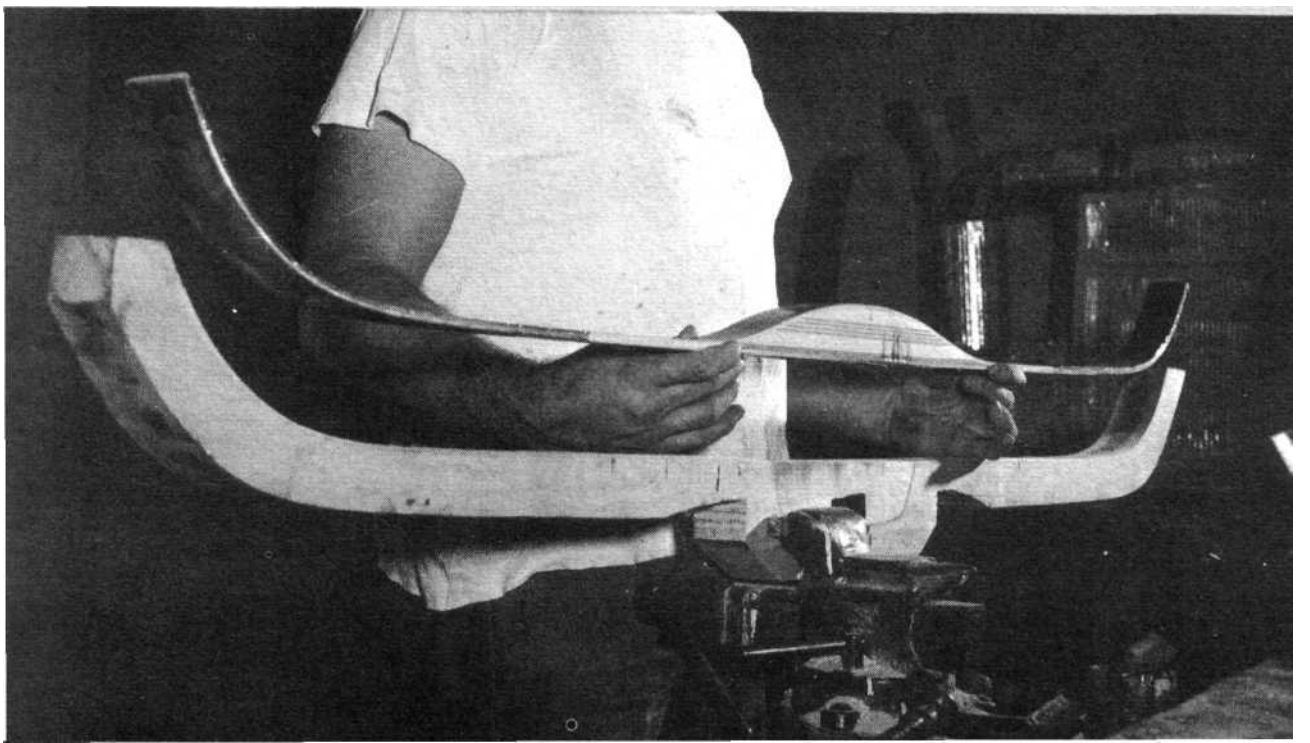
Glued bow assembly is clamped to steel form and dried in heating chamber in professional set-up.

Howard Hill dries his bows with heat of a blow torch directed into improvised drying chamber.

glued. Allow 24 hours drying time, the first six hours at at least 100 degrees Fahrenheit. A closed car in the summer sun will usually get at least this hot. Another trick is to wrap the glued assembly in a sheet of canvas that has been treated for water-proofing and let this lie in the direct sun. The heat will build up in the canvas wrapping to a very high degree. Howard Hill improvises a drying chamber by wrapping a length of 10-inch stovepipe with asbestos, closing it off at both ends, but leaving a small enough opening at one end through which to direct the heat of a blowtorch.

While the assembly is drying, make a wooden form for shaping the billet. This form should be bandsawed out of a 2-inch thick solid wood block that is seven inches wide and 70 inches long. In the absence of solid wood, plywood can be used by laminating two lengths of 3/4-in. and one length of 1/2-in. plywood together to build up the 2-inch thickness required. Cut the form out to the shape shown in the diagram, making sure that both ends of the form cut out are identical in shape. The best way to assure this is to make a template, from heavy cardboard or thin sheet metal, of one half of the desired shape, then trace this onto the form block, first on one end of the block and then, flopped, on the other end of the block. The form, when cut out, should be perfectly square to insure a firm even base for clamping the glued laminations. After cutting out the recurve contour, draw a line on the form parallel to

After drying by heat at recommended temperature, bindings are taken off and billet is removed from form. Billet will have taken recurve shape. Clean and square up both sides of the billet by sanding.



this shape and spaced three inches from it and cut away the excess wood along this line. The precision and evenness with which you make this form will determine the quality of your finished bow to a great degree.

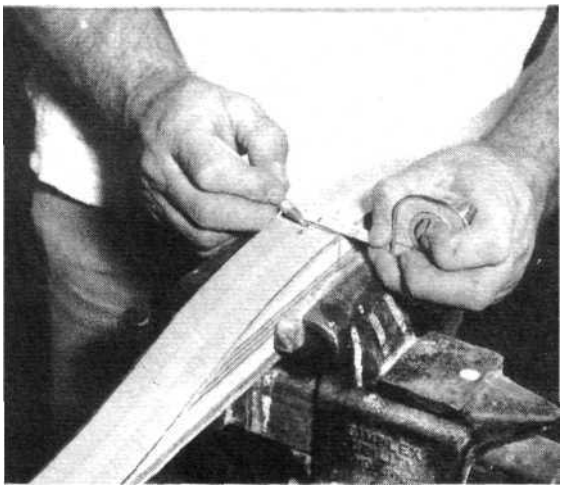
After the bow assembly has dried, clean the excess glue off both sides of the riser section and then lay out the curve it is to be cut down to as shown in diagram (Step No. 3). Since both sides of the riser section fadeouts are the same shape and equally distant from the center line, a half template can be used in both positions to trace the curve onto the riser section. The fadeout *must* be a very gradual curve into the base or core lamination. This is essential to the final tiller of the bow.

Use a band saw or jig saw to cut out this curve but do not cut into the fade-out lamination. The gradation of the fadeout is too critical an operation to be done with a saw. It should be done by careful sanding, preferably using a drum sander, until the fadeout gradually blends into the core lamination. Be very careful not to cut *into* the core lamination or leave even the slightest ridge at the end of the fadeout. Cutting into the core lamination will weaken the bow at that point, while leaving a ridge will stiffen the limb, add to the bow's weight, and interfere with the bow's performance.

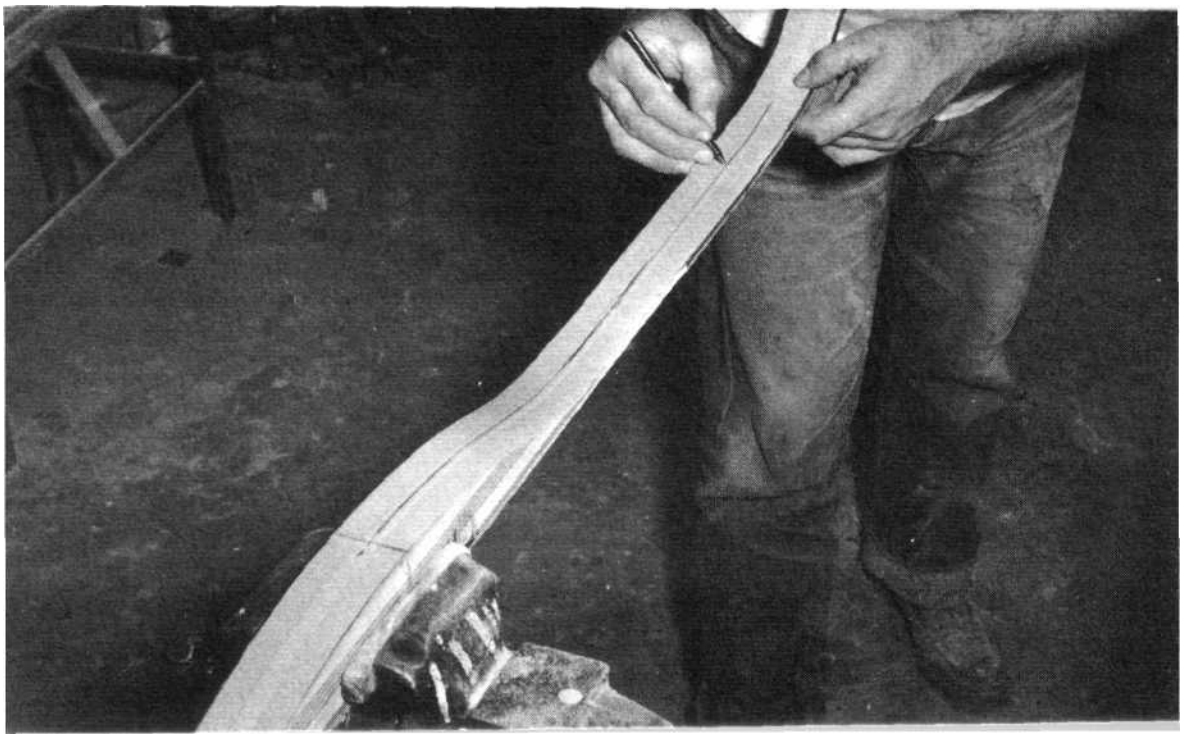
The next step is to glue the second pair of core laminations to the bow assembly. This operation is performed in the bow form in order to establish the recurve shape. The

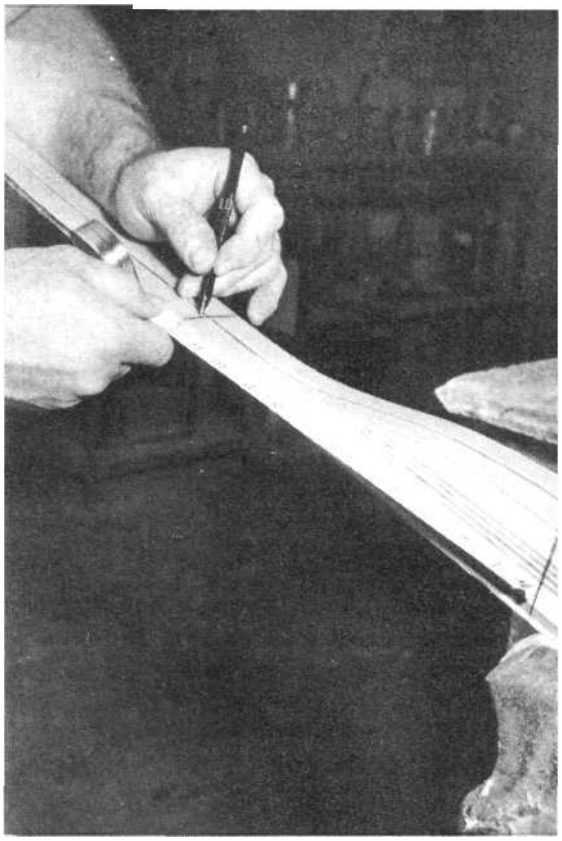
Cover outer Fiberglas surfaces with masking tape for protection and to facilitate marking layout

Using a flexible tape measure or rule, establish the center of the bow, taking care to be precise

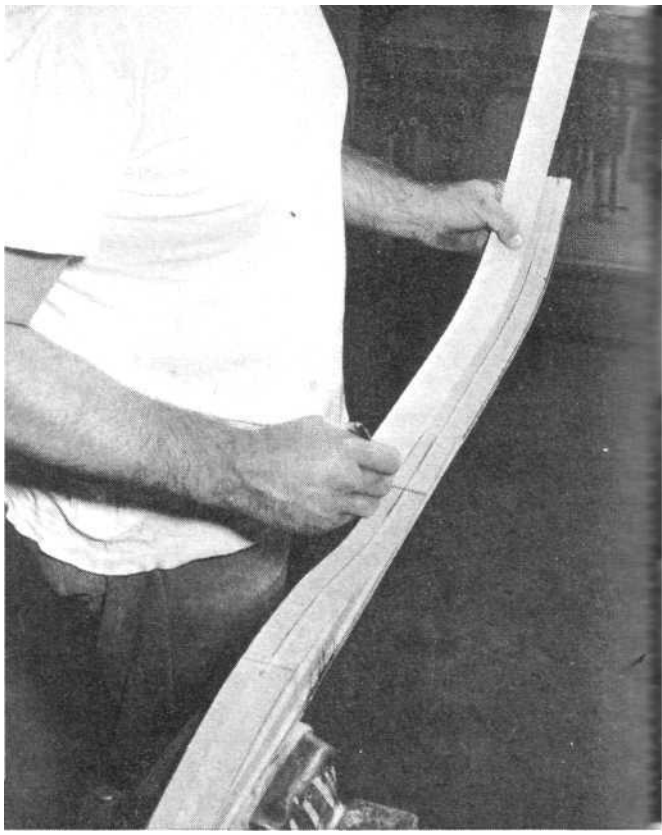


Now draw two center lines on the bow. one crosswise and the other lengthwise. All measurements should be very carefully made as even a slight error will be reflected in the accuracy of the finished bow.





Measure exact distance from, center to end of either fadeout. Mark off equal distance other limb.

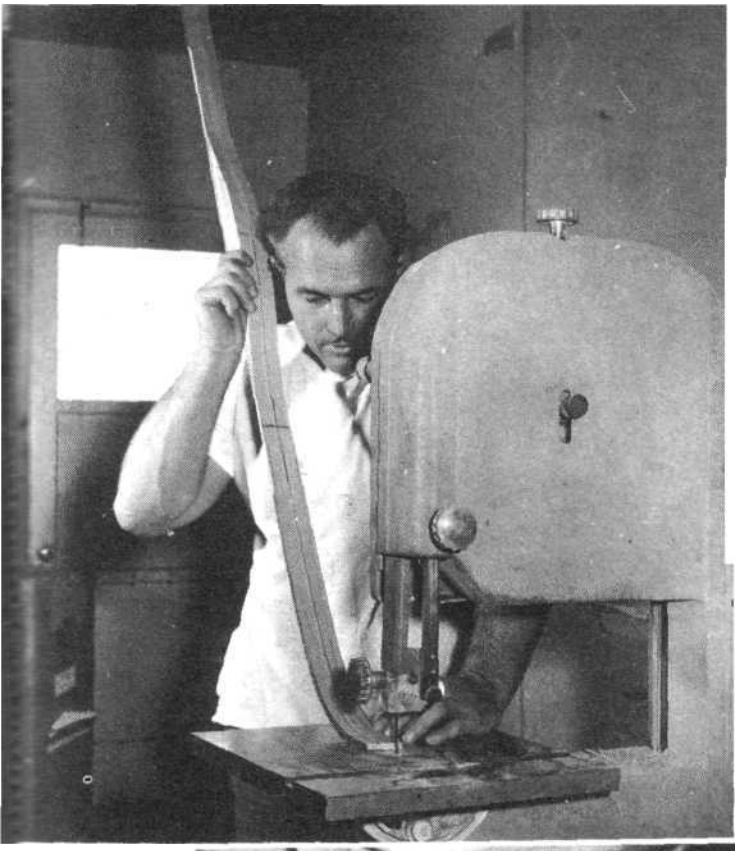


Mark off bow tips for required width, then lay out limb tapers from end of fadeout to bow tip.

best way to do this is to set the two strips end to end and secure them together temporarily with masking tape across their outer surfaces. Then apply glue to the inner surfaces of both strips and the back surface of the bow assembly. Now join the laminations together, centering the taped joint with the center line on the riser section and lining it up with the center line on the bow form. Do this in the form, using a C-clamp on the center line to clamp the assembly to the form. Then, starting at the center point and using loops cut from an old inner tube, numerous clamps or masking tape, secure the laminations firmly to the form. To facilitate removal of the billet from the form, wax paper should be placed between the form and the laminations. Also, because the rubber loops and tape, when tightly wound around the assembly, exert most of the pressure on the edges of the laminations and very little in the middle, a spacer strip, consisting of "a strip of wood 1/16 in. thick and 1/8 inch narrower than the laminations, should be laid along the top of the billet and centered to leave a 1/16-in. margin along each side before the tape or rubber loops are wound around the assembly. This spacer strip will equalize the pressure exerted over the entire surface and insure a good glue line. No glue is applied to this spacer strip.

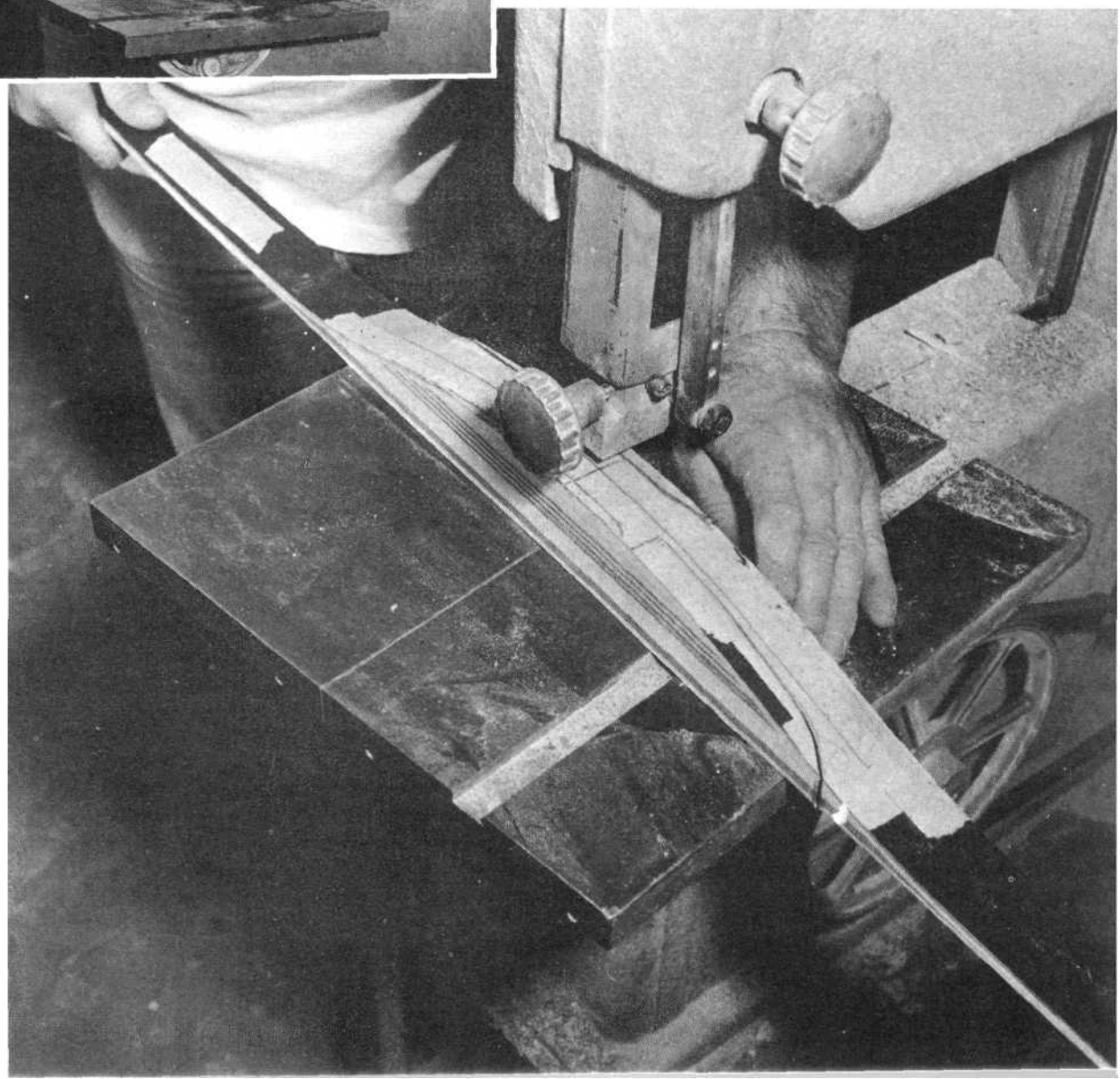
As you work your way toward the bow tips, the laminations will be forced down into the form and will take the shape of the curve cut into the form. Do this along both ends, securing the entire length, then set the form into a hot place to dry. Because extreme heat may melt natural rubber, loops preferably should be cut from one of the synthetic-type tubes which are more heat resistant. Dry the billet at no less than 100 degrees F. When the glue dries, the laminations will retain the shape of the form. Clean off the excess glue from the sides of the core and, with No. 1/2 grit sandpaper, clean off any wax that might have transferred to the core from the wax paper.

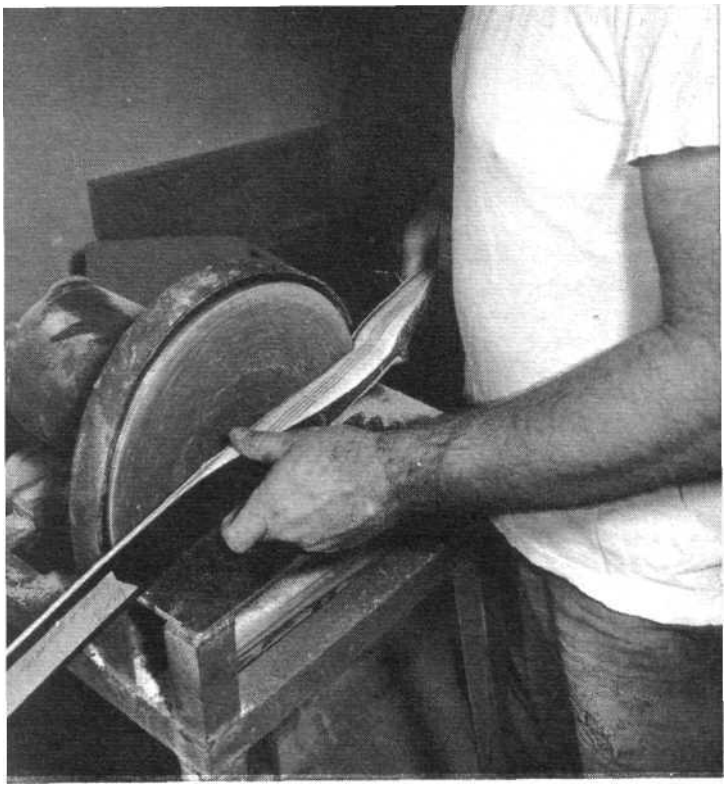
The next step is to apply the Fiberglas to the bow assembly. The Fiberglas is obtained in two thicknesses, the heavier strips being used on the belly of the bow and the lighter ones on the back. Rough the sides of the glass to be glued (either side can be



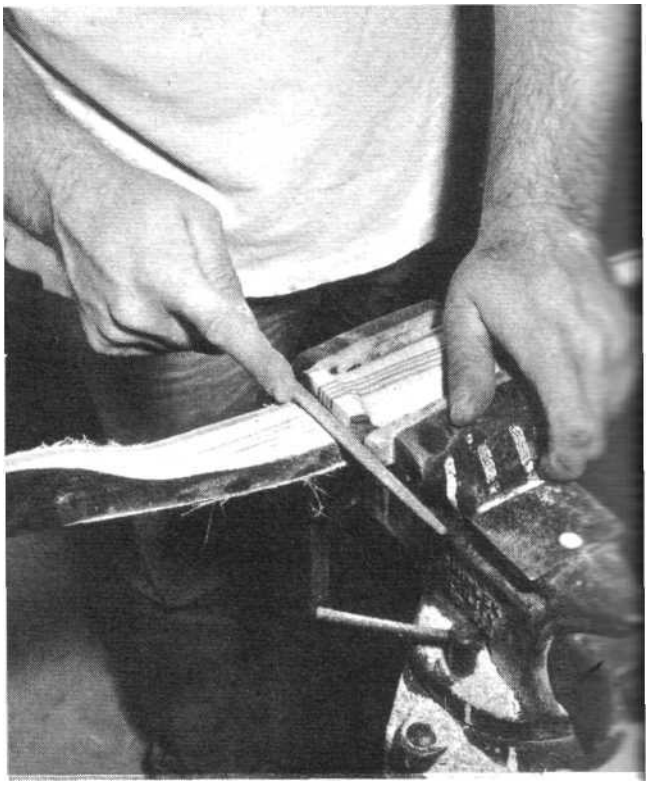
Cut away the excess limb. Clean and iace the edges up to the layout lines, rounding Fiberglas slightly with a mill file.

Having determined which is to be the upper limb and which the lower, lay out the handle and sight window and cut to shape.





Following the photos on these pages, rough shape the bow handle, on a disc sander if you have one.



Curve top surface of the arrow rest slightly so that shaft does not rest on too broad a surface.

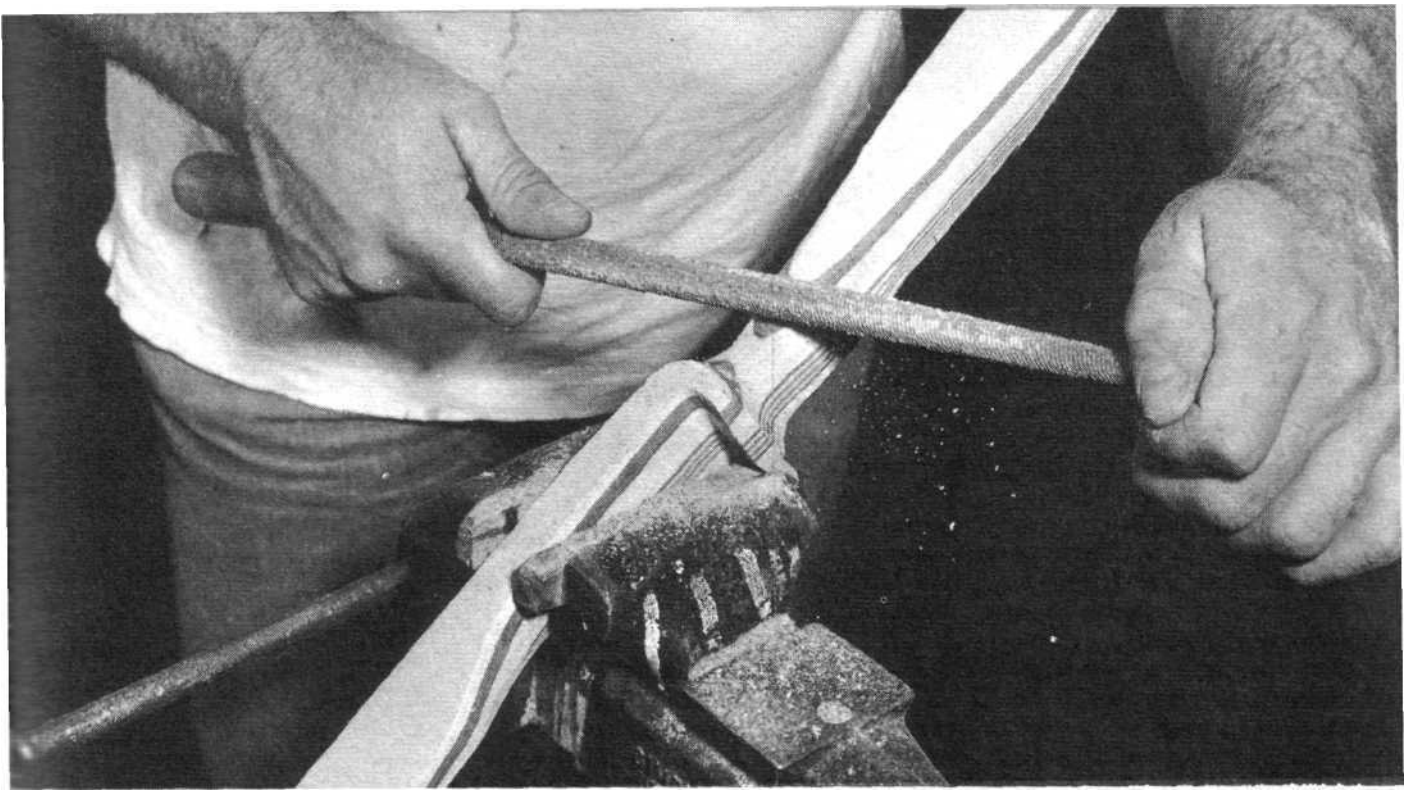
used) with very coarse sandpaper, preferably using a drum sander, to remove all the glaze. Do not be afraid to sand.

Next, join the two strips of back glass end to end with masking tape applied to the side opposite the one roughed up for gluing and lay this glass, rough side up, into the form. The wooden bow assembly then sets in on this, and the belly glass, joined end to end with masking tape like the back glass, is set on top of the whole assembly. This is a "dry run" to make sure that all the component parts are properly sanded and ready for gluing. It is a good idea to cover the outer surfaces of both the back and belly glass with masking tape. The tape will keep the glass clean and provide a surface for measuring and marking off the limb tapers to be cut later.

Now, using M-74 plastic glue and C-31 hardener, apply glue to the roughened glass surfaces first, then to both sides of the wood core, using a 1-1/2-in. brush. Plastic glue and hardener should be applied *immediately* after they are mixed. The glue is mixed four parts adhesive to one part hardener by weight. Add the hardener to the resin and stir for five minutes. The maximum time you can allow the mixed glue to set in the pot is five to 10 minutes. However, once it is spread on the laminations and glass, you have 30 minutes to join and clamp the pieces together. Glue surfaces must be absolutely free of moisture.

After you've glued the surfaces, set them into the form with a spacer strip laid across the top as was done when gluing the second pair of laminations to the first, and after lining up the center mark with the one on the form, use a C-clamp over the center mark to hold the assembly to the form. Then, as was done before, wrap the billet tightly to the form with loops of inner-tube rubber or masking tape, starting from the center point and working your way toward the tips. The glass will take the shape of the curved form as you carry the wrappings outward. Be sure to save some of the plastic glue and hardener (in unmixed form) for the tip blocks. Dry the billet with heat of at least 120 degrees F., but not over 140 degrees, for six hours, then let harden for another 48 hours. Important: this glue will not function properly without observing the stated degree of temperature.

You now have the completed billet. Clean and square up both sides of the billet with very coarse sandpaper, using your disc sander. Leave the masking tape on the bow for use in marking the layout. Now draw



Final shaping is done with files. You can shape the sighting window to your own requirements, there being no hard rales concerning the location oi the window or the depth to which is should be cut.

two center lines on the bow, one lengthwise and the other crosswise. From the crosswise center line, measure the distance to the exact end of the fadeout on one side and draw another crossline at this point. Then measure an equal distance on the other side of the center line and draw another line across the bow belly. These lines at the ends of the fadeout will mark the points from which the bow limbs begin to taper toward the tips.

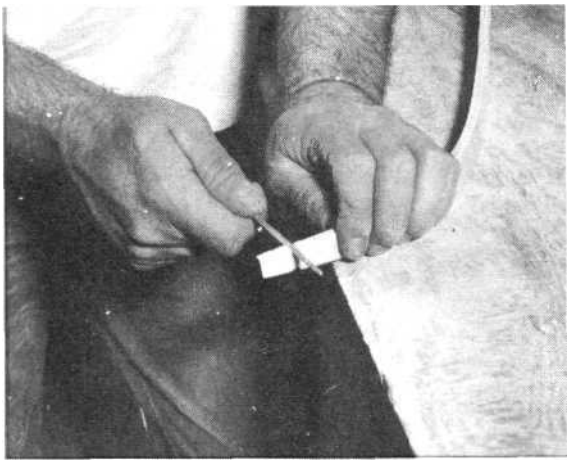
Next, at the tips of the bow, measure % inch from each side of the longitudinal center line. This will give you %-inch wide bow tips. Now draw diagonal lines from these bow tip marks to the outer ends of the fadeout cross lines and you will have the correct limb taper as shown in diagram. For a 25 to 30 lb. lady's bow, the billet, which is normally 1-5/8 in. wide, should be narrowed down on a disc sander to a width of 1-1/2 in. and the limb taper should end up with 5/8-inch-wide tips instead of 3/4-inch.

After marking off the limb tapers, cut away the excess limb along these lines and then clean and face the edges up to the layout lines. Round the glass slightly on the face and back with a mill file, but do not go to too much trouble because these Limbs are rough width at the tips and will be changed when the bow is lined up.

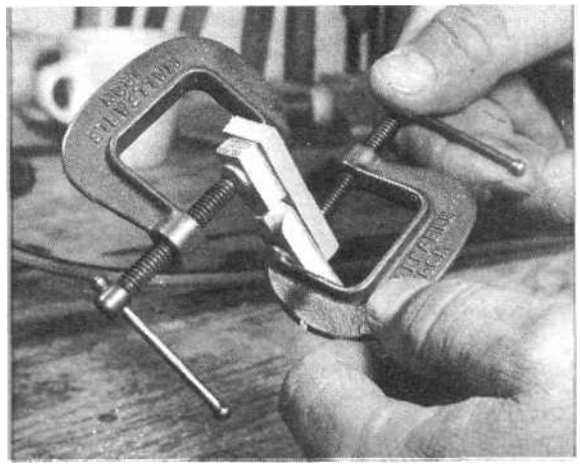
Next, locate the points for the string grooves by measuring 33 inches each way from the center line with a flexible tape or rule, letting the rule follow the curve of the bow along the belly. Use a small round rat-tail file and file the string grooves 1/8 inch deep on both sides of the tip, rounding them off slightly to prevent their cutting the tillering string.

You are now ready to string the bow for tillering. The tiller is the shape of the bow at strung position. Use a string with large loops for the tillering string. After stringing up the bow, check its limbs for evenness by sighting along the string from tip to the middle of the main part of the limb as shown in photo. If the recurve twists to one side of the middle of the limb, remove material on that side and refile the string groove on that side. Repeat this process until the recurve is in the middle of the main part of the bow.

After the tips are in line, sight along each side of the limb and file out any bumps you may see. In doing this, you may change the tiller of the bow, so check frequently to see that the recurves do not take on an off-side twist. If they do, you can correct it by tak-



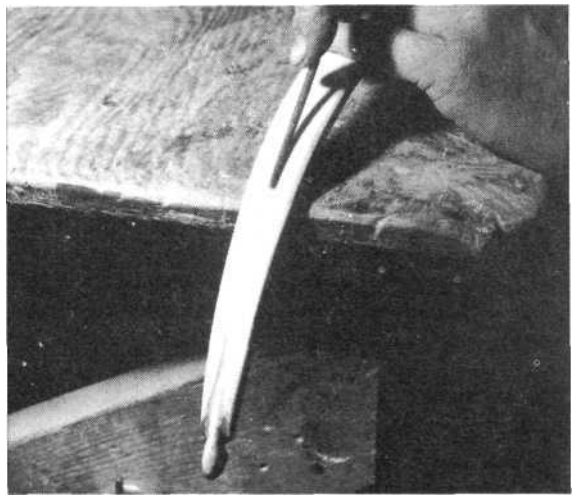
String grooves, 1/8 inch deep, are filed into both sides of each bow tip using small rat-tail file.



Glue tip blocks to bow tips over string grooves; Fiberglas should be well roughened before gluing.

Shape bow tips to the contour of the bow limbs. File string grooves into tips with rat-tail file.

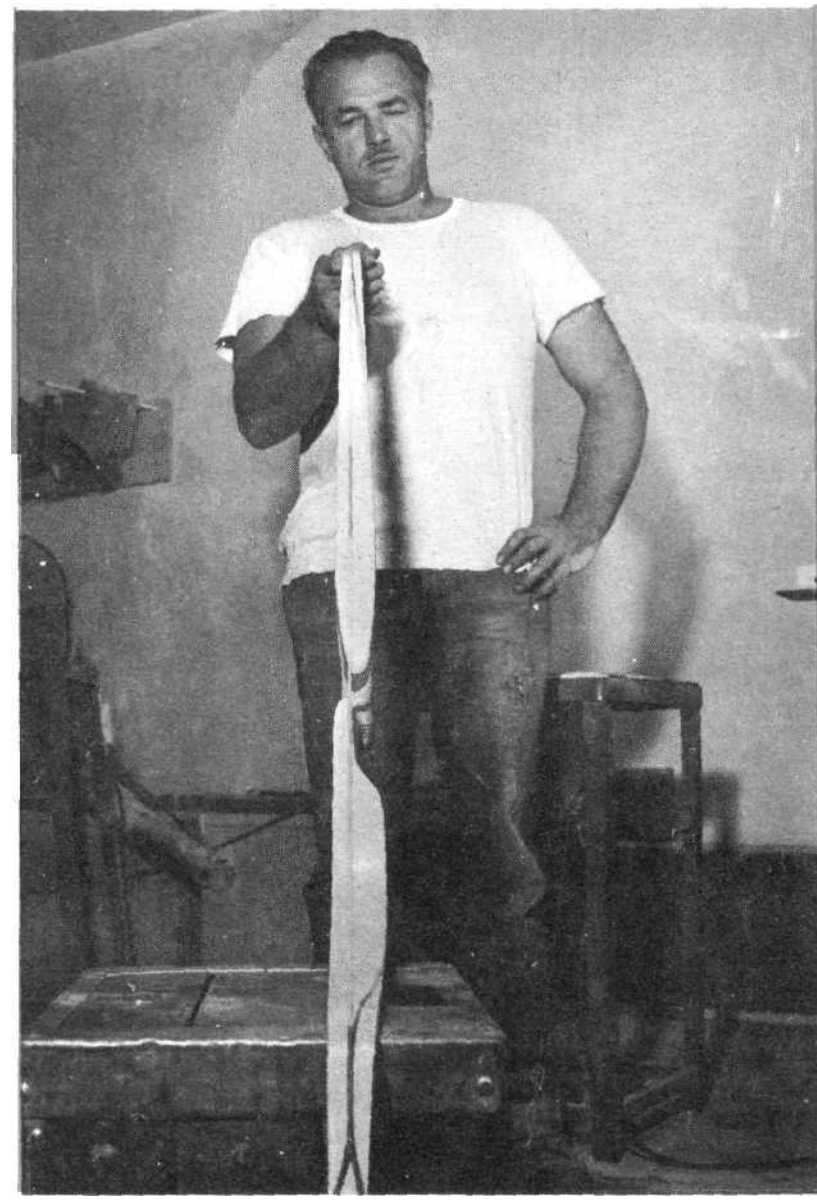
Finishing off the bow, file string grooves along the recurve cm belly side of each of the limbs.



ing off sufficient material from the side to which the limb twists to even out the limb.

Before the handle can be shaped out, you must determine which limb will be the upper limb, since the upper limb should be weaker than the lower limb. This is because when drawing the bow, you will be exerting more palm pressure below the center line on your grip, as well as putting more tension on the lower half of the bow string due to having two fingers below the nock of the arrow and only one above it. To equalize this, the lower limb of the bow should be a little stiffer than the upper limb, and you determine this by measuring the distance between the bow string and the limb curve at the point of the fadeout on both limbs. The points along the limbs at which you take this measure should be equidistant from the center line of the bow. The weaker limb should then measure 3/16 inch more between limb face and string than the stronger limb and this limb should be used as the upper limb. If it measures less than 3/16 inch, you can lighten the limb by rounding the face glass slightly.

Having tillered the bow and determined which is to be the upper limb, you can now mark the handle for the grip and window cutout as shown in diagram, lining it up so that the window cutout is on the upper limb. Cut out the handle as shown in photos with files and disc sander; round out the handle and sight window to the desired shape as shown in diagram. You can shape this to your own taste, there being no hard and fast rules concerning the location of the sight window and the depth to which it



String the bow and check the limbs foi evenness by sighting along the bowstring from tip to tip. If recurve tends to twist to one side, correction can be made by removing additional material from side to which limb twists, refiling string groove on that side.

should be cut. However, it should not be cut to a depth greater than 1/8 inch from the longitudinal center line as shown. This sight window should be cut on the left side of the bow (as bow is seen by archer when shooting) for right-handed shooters, on the opposite side from that shown in the diagram for left-handed shooters. File a slight curve into the top surface of the arrow rest so that the shaft does not rest on too broad a surface when shooting.

Filially, cement the tip blocks to the bow tips over the string grooves. Finish off the tips by shaping them down to the contour of the bow limbs and filing the string grooves into them with a rat-tail file.

Your bow is now ready for sanding and painting. Sand to a fine smoothness and paint with clear varnish or lacquer.

SOME FINAL TIPS:

1. When removing masking tape, strip from center of bow out toward tips so as not to lift any glass splinters along the edges. Use care.
2. When filing bow, always file toward glass to avoid chipping.
3. Before any clamping, always have a "dry run" before applying glue.
4. Remember, you must use heat to cure this glue right.
5. Glass surfaces to be glued must be roughed thoroughly.
6. Extreme care should be used in fadeout to avoid gouging base lamination or have fadeout end too abruptly.
7. Do not get impatient to shoot bow before it is finished. •