

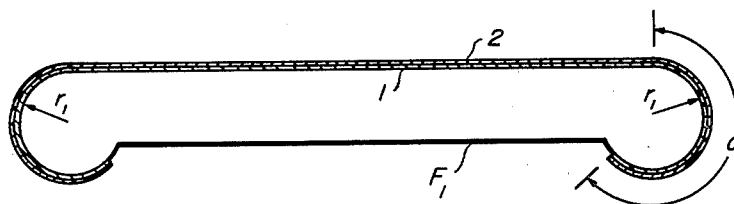
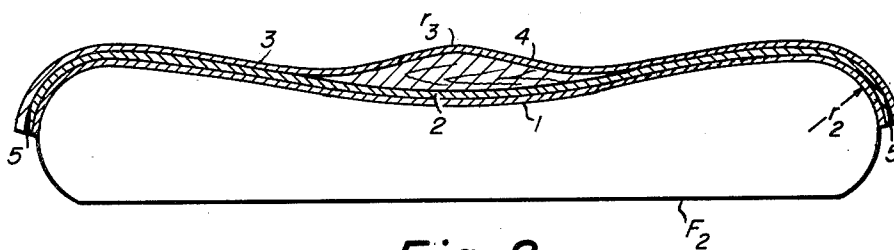
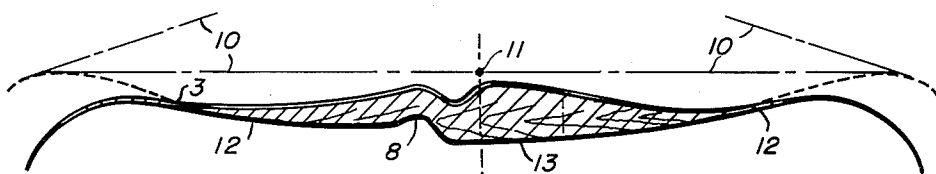
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METHOD OF MAKING A PRESTRESSED ARCHERY BOW

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METHOD OF MAKING A PRESTRESSED ARCHERY BOW

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The present invention relates to archery bows, and deals particularly with archery bows which are prestressed prior to use.

In modern archery, considered either as a pure sport such as target shooting or as a useful pursuit such as game hunting, there are a number of features which should be characteristic of a high quality bow. A good bow should cast arrows at high velocity. It should be consistent, i.e., cast successive arrows over identical trajectories under identical bowstring draws, and should cast any arrow with a velocity varying directly with the amount of draw. It should also have great durability, maintaining its accuracy and ability to cast arrows at high velocity after extended periods of use in all types of weather. Finally, operation of the bow should not unduly be fatiguing to the archer, even after hours of continuous use.

It is the primary object of the present invention to provide an archery bow having such desirable characteristics.

More specifically, an object of the present invention is to provide an archery bow capable of imparting higher velocities to arrows than prior art bows.

Another object is to provide a bow having a uniform draw-force characteristic up to and even well beyond the usual full draw length.

A further object is to provide an archery bow requiring less force per unit draw when the bow is flexed through the last increments of full draw than prior art bows of comparable draw force at full draw.

Another and further object is to provide such a bow having greater durability and less weight than prior art bows.

The above and other objects are accomplished with bows of the present invention by providing a laminated structure having a novel prestressed structure which makes possible a considerable reduction in limb thickness, bulk and weight of such bows. The prestressing method of the present invention, together with the reduction in limb thickness, makes the resulting bows smooth drawing up to and above the normal full draw, makes it possible to flex such bows through any number of consecutive casting cycles without breakage or letdown, and tremendously reduces the muscle strain normally experienced by an archer in a long shooting session. It also increases the archer's accuracy by reducing the trajectory error of his shots, for the reason that a draw which deviates by a small amount due to human error from the desired full draw causes only a small deviation from the desired arrow velocity. An identical deviation in draw length in many of the prior art bows, requiring as they do, much larger increments in draw force at the end of the draw than at the beginning, causes a large deviation in arrow velocity and hence a large trajectory error.

The present invention will be more readily understood by referring to the accompanying sheet of drawings, in which:

FIGURE 1 is a side elevation illustrating the bow of the present invention in the first steps of assembly, with the backing strip and core on the prestress form,

FIGURE 2 is another side elevation showing all three laminations, including the facing, assembled on the final form, together with the handle riser and end wedges,

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FIGURE 3 is an elevation of the completed bow, as held in the braced position by the string, and

FIGURE 4 is an elevation from the back of the completed bow.

Referring now to FIGURE 1, the bow is built up from a backing 1 of glass cloth impregnated with a cured thermosetting resin bonded to a wood core 2 by a urea or epoxy resin glue. The strips are clamped to form F_1 by clamps (not shown) while the glue is wet, and the assembly is heated to set and cure the glue. The clamps are then removed, and the two-part assembly substantially retains the shape of the form.

This assembly is then removed from form F_1 and forced onto form F_2 , as indicated in FIGURE 2, in the course of which backing member 1 is stressed in tension and core 2 is stressed in compression. The facing or belly layer 3 is the same type of glass cloth as is used for layer 1 and is next affixed to the assembly.

Hardwood handle riser 6 and wooden end wedges 5, are wetted with glue and laid against the core 2. The outer surfaces of the core 5, handle riser 6 and wedges 5 are spread with glue and the belly layer of glass cloth laid against these surfaces. The assembly is clamped and heated as before. When the glue has been set, the clamps are removed. The three layer assembly retains the shape of the final form F_2 . Handle riser 4 may, if desired, be made of two contrasting woods to achieve a decorative effect.

It should be noted that the construction of bows, in accordance with the present invention, results in a complete heavy center section 13, essentially unyielding, and a pair of highly flexible limbs 12, the latter having an average thickness of about $\frac{3}{16}$ inch.

The width of the laminated bow is then reduced or tapered from a maximum at the handle to a blunt tip at each end (FIG. 4), the extent of such taper varying somewhat with the draw force for which the particular bow is designed by methods well known to bow designers. The center of the bow is cut to provide an arrow rest 7 and a handle grip 8, and the ends are nocked at 9 for the string loops, as indicated in the back elevation of FIGURE 4. The bow is then given a final smoothing and varnish treatment.

In use the bow is flexed to the braced position and the string 10 is added, as indicated by the dashed lines in FIGURE 3. In comparison with the stresses in the unbraced position, such flexing increases the compressive stresses in the facing layer 3, and increases the tensile stresses in backing 1. The longitudinal fibers of core 2 adjacent to backing 1 acquire an increase in compression while the compression in the fibers adjacent facing 3 is reduced, the end condition of the stress in these fibers probably being one of tension. The neutral plane of the braced bow lies somewhere in the core between its interfaces with the backing and the facing.

It should be noted that one result of the above-described prestressing is a condition of safety for the archer. If the bow should break when the string is drawn, it will be much more likely to fracture the backing before the facing, as the greatest stress is in the backing.

A nocking point 11 may be provided by a knot in string 10 to insure that an arrow may be readily lined up with arrow face 7 for accurate center shot casting. This provision is particularly useful in game hunting, as it enables the archer to select an arrow from his quiver and line it up in the bow without losing sight of his quarry.

Suitable materials, dimensions and process variables are listed below for a bow measuring 68 inches from tip to tip along the contour of the bow. These are not intended to be limiting, as such bows may be built in any

preselected length and with a wide variety of draw forces at full draw.

Backing and facing: 68" x 2" x .050-.060" glass fiber cloth impregnated with polymerized epoxy resin.

Core: 68" long strip of maple, 2" wide, 0.135" thick at the center tapered .002" per longitudinal inch to each end.

Handle riser: Maple, oak, or other hard wood.

End wedges: 6" long x 2" wide, 1/8" thick at bow end tapering to zero. Maple or other hard wood.

Radius r_1 of FIG. 1: 4 inches.

Circumference C of FIG. 1: 20 inches.

Radius r_2 of FIG. 2: 8 inches.

Radius r_3 of FIG. 2: 60 inches.

Thickness (maximum) of handle riser (FIG. 2): 3 1/8 inches.

Length of handle riser, tip to tip (FIG. 2): 31 inches.

Glue: Urea resin or epoxy resin base.

Heat treatment on each form: 190° F. for 2 hours.

Draw force: 42 pounds at 28 inches.

Using the above-described bow at a standard 28" draw, 20 arrows weighing 400 grains each were cast at velocities ranging from 198 to 210 feet per second, as measured with an electronic chronograph. An identical number of tests with identical arrows cast by three prior art bows requiring the same draw force at 28 inches indicated, for such conditions, 160-172 ft./sec. for bow A, 145-165 ft./sec. for bow B, and 145-163 ft./sec. for bow C.

The 68-inch bow of the present invention has a linear draw force characteristic up to and well beyond the standard full draw of 28 inches. There is no tendency towards nonlinearity or "stacking up" detectable below a draw of 36 inches. This linearity between draw force and draw length is particularly important in avoiding or minimizing trajectory errors. Thus, with the 42 pound bow of the present invention, a force of 1 1/2 pounds is required for each inch of draw up to and beyond 28 inches, while in comparable prior art bows the force required may increase from 1 1/2 pounds per inch at the start to 4 pounds per inch at 28 inches. It is apparent that a draw which is 1/2 inch short of full will cause an error of 3/4 of a pound in the draw force of the bow of the present invention and that the corresponding error using the prior art bow is 2 pounds, with corresponding errors in arrow velocities and trajectories. Such errors are especially likely to be committed in the use of prior art bows which stack up at full draw, in particular after prolonged use, as the fatigued archer is prone to draw short under these conditions.

Another important advantage of the present bow is the reduction in thickness made possible by prestressing in accordance with the teachings herein. Thus, the above-

described bow is 23% thinner in limb thickness than is an equivalent bow without prestressing. The result is a reduction in fatigue to the archer, both because of the lighter weight and the uniform draw described above. In addition, a tremendous increase in durability is obtained over prior art bows. The thinner limbs of the present bow are very flexible and have no known point of failure through repetitive cycling. They may be flexed to draw lengths up to 46 inches without breakage.

The above description is to be considered as illustrative, and not limiting the invention of which modifications may be made without departing from the scope of the invention as set forth in the appended claim.

What is claimed is:

- 15 A method of fabricating a prestressed archery bow having the characteristics of high casting velocity, uniform draw-force, and great durability, comprising the steps of applying a glue between a backing lamination of resin impregnated glass fiber cloth and a core lamination of flexible wood, clamping said laminations to a first form having an essentially flat center section and asymptotically joining convex end sections of equal and relatively small radii until said glue sets, said laminations being sufficiently long to extend around at least half the circumference of each end section of said first form and being held against said form with said backing in contact therewith, fitting such bonded lamination to a second form having a symmetrically disposed center section of a curvature to accommodate a rigid hardwood handle riser of bi-convex cross section, said handle riser having front and back surfaces meeting asymptotically at each tip, said center section of said second form having convex end sections of larger radius than said end sections of said first form, gluing such a handle riser to said center section on said second form and gluing a facing layer of resin impregnated glass fiber cloth to said core lamination and said handle riser, said laminations and handle riser being rigidly clamped to said form during the setting of said glue with said backing lamination facing inward.

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