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 [33] **Japan**
 [31] **42/74,401**

[56]

References Cited

UNITED STATES PATENTS

2,591,768	4/1952	Austin.....	273/167UX
2,654,608	10/1953	Liebers.....	273/169

OTHER REFERENCES

"Archer's Bible" Catalog; Published 1966, Apparently distributed by Kittredge Bow Hut, Mammoth Lakes, California, Pages 14, 15, 20 Relied on.

Primary Examiner—Richard C. Pinkham

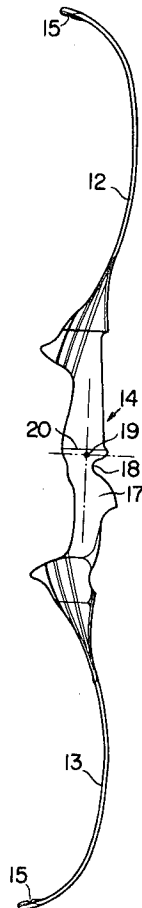
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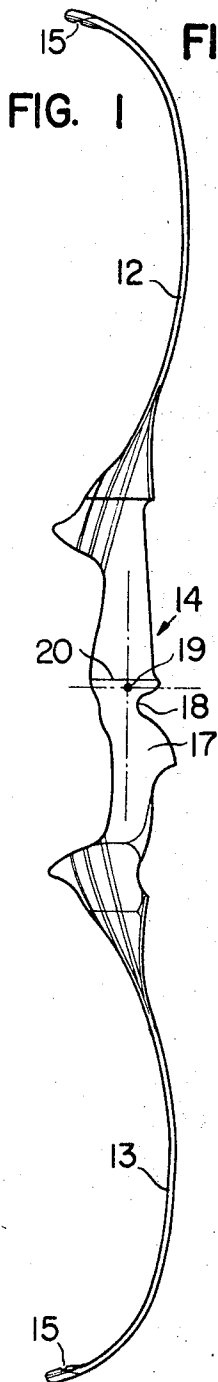
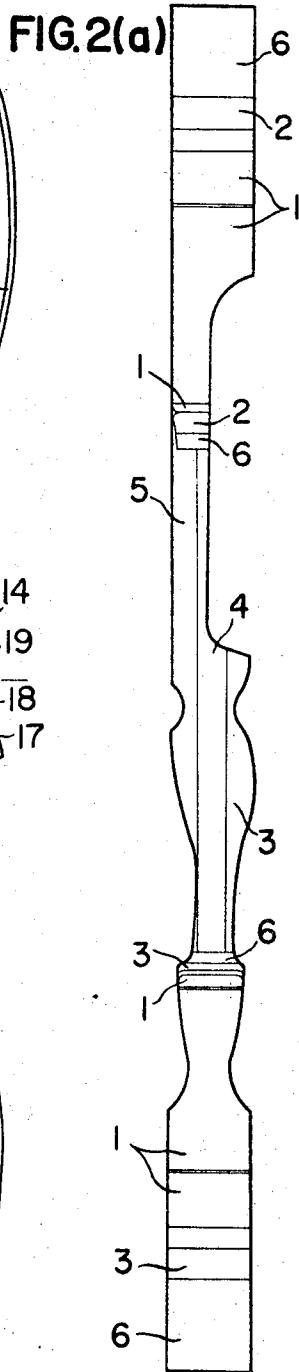
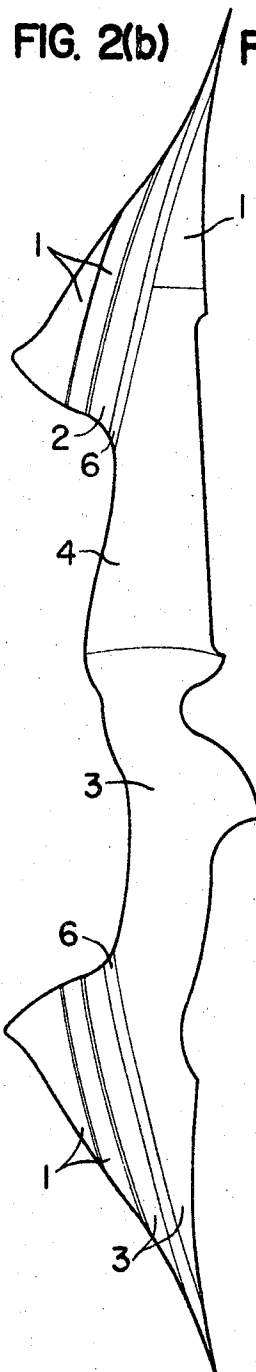
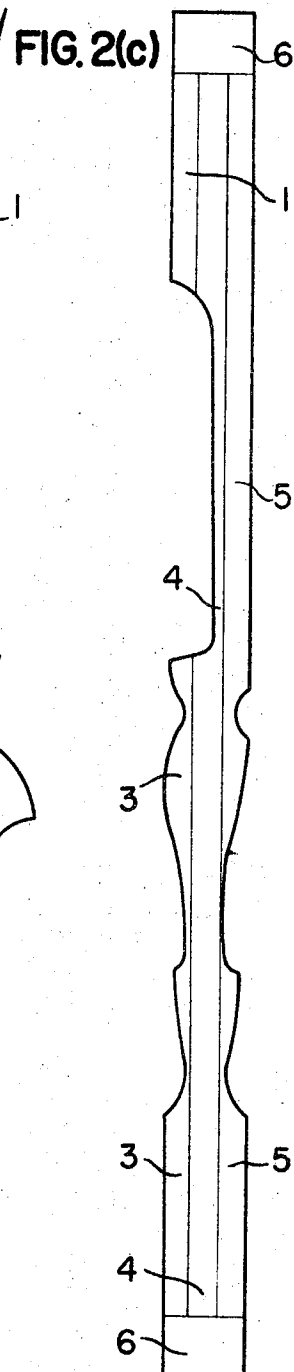
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[54] **HANDLE RISER SECTION OF ARCHERY BOW**
3 Claims, 7 Drawing Figs.

[52] U.S. Cl..... **124/30,**
124/24
 [51] Int. Cl..... **F41b 5/00**
 [50] Field of Search..... **124/23, 24,**
30; 273/167, 169, ("Archer's Bible" 1966 and 1968)

ABSTRACT: The handle riser section of an archery bow is defined by laminates of resin-impregnated wood pieces of different specific gravities so positioned that the upper and lower ends of the handle riser section have higher specific gravities than the other parts of the section, whereby a bow of high static and dynamic stabilities, great durability, consistently uniform characteristics, and an aesthetically pleasing external appearance can be produced at a low cost and reproduced in large quantities.





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FIG. 3(a)

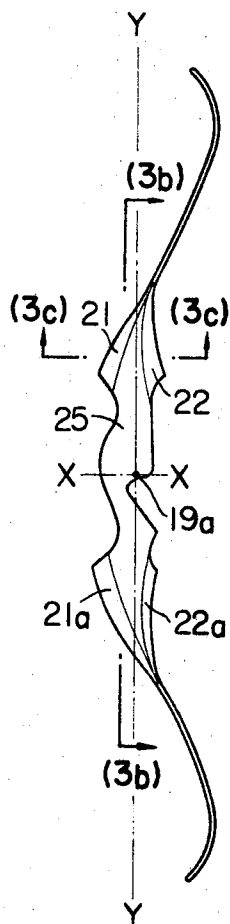


FIG. 3(b)

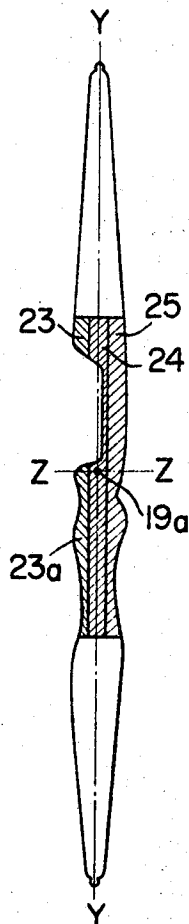
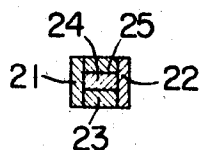


FIG. 3(c)



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HANDLE RISER SECTION OF ARCHERY BOW

BACKGROUND OF THE INVENTION

This invention relates generally to archery and more particularly to the handle riser section of an archery bow. More specifically, the invention relates to an archery bow having a construction in which the upper and lower ends of the handle riser section have a composite construction (hereinafter referred to as WPC) of wood and plastic (synthetic resin) possessing relatively higher specific gravities than the other parts of the handle riser section.

The term "handle riser section" is generally used to designate the nonflexing part of the bow including the handle grip and disposed intermediate the inner ends of the upper and lower limbs, the handle riser section is of substantial length in the longitudinal direction of modern bows.

Archery bows may be broadly divided into three common classes, namely, field or hunting bows, tournament (target) bows, and special bows such as flight bows. Tournament bows are used in competitions in which scores or points are earned by the degree of accuracy with which arrows shot by the bows strike specific targets, and the difference between winning and losing in such competitions is often determined by very slight differences in the positions at which the arrows strike the target.

Accordingly, a bow to be used in such competition must have the capability of directing an arrow to the target accurately as aimed by the archer or bowman, that is, to have, above all, stability.

An archery bow may be considered to possess two kinds of stabilities. One is "static stability" which must be considered from the procedure of nocking an arrow through a full draw of the bow string to the anchor point and "holding" the arrow (*i.e.*, from drawing of the bow through aiming). The other is "dynamic stability" which must be considered from the instant of release of the drawn bowstring to cause the arrow to be propelled to the time when the entire bow assembly including the bowstring returns to a state of complete rest.

When the bow assembly is in a fully drawn state with an arrow nocked in place, the force pulling the bowstring and the force pushing the bow at its pivot point of the handle are in a state of equilibrium. However, the bow assembly is by no means fixed and supported in a fully rigid state at its pivot point. Consequently, at the instant when the bowstring is released and the arrow is propelled, an angular motion of the bow about its pivot point is caused by a torque imparted to the bow assembly.

Furthermore, once the drawn bowstring separates from the archer's hand, the state of equilibrium of forces is disrupted, and the potential energy which has been stored within the bow assembly is transformed into kinetic energy and transmitted to the arrow, which is thereby propelled. Generally, the potential energy of the drawn bow converts into the kinetic energy of the arrow by approximately 70 percent, and into the kinetic energy of the bow assembly by approximately 30 percent.

This latter of the energy transformations causes irregular dynamic effects of the bow. More specifically, there arises simultaneously a dynamic motion such as mechanical vibration due to causes for example, the physical natural vibration induced by the energy transformation within the structure of the bow assembly, the striking of the returning bowstring against the face of the upper and lower limbs of the bow, and/or the shock effect produced by the suppression of the free vibration of the bow assembly as an elastic structure due to the presence of the bowstring.

In addition, inertial motion (that is, translational and angular motion around the pivot point) due to an insufficient mass or mass unbalance occur, whereby the irregular motion of the bow assembly is further intensified. This irregular motion occurring in the interval from the instant the bowstring is released to the instant the arrow leaves the bow gives rise to a deviation in the direction of the arrow projected and, to a disturbance of the trajectory in flight due to deviating forces imparted thereto.

One possible expedient for restraining such irregular motion of the bow assembly, or for eliminating at least the causes of the irregular motion which the archer cannot control, is to increase the mass of the bow assembly, particularly that of the handle riser section. The total weight of a bow assembly has an upper limit in that it must be sufficiently light for the archer to support and, also operate easily. In general, the total body weight of a bow assembly is preferably 1.7 kg. or less, and the weight of the handle riser section 1.5 kg. or less.

Accordingly, the mass distribution of the bow assembly should be such that, within a certain upper limit of the weight, the mass moment of inertia of the entire structure is increased.

A disadvantageous feature of the handle riser section of a modern bow (as developed principally in the U.S.A.) in the ordinary form is that the upper and lower parts of the handle riser section cannot have a symmetrical configuration. In a structure made only of wood, as in the known handle risers, the degree of freedom with which combinations of volume and specific gravity can be selected is low, and it is difficult to obtain a combination meeting desired conditions. Consequently, such bows have had low moments of inertia caused by a mass unbalance due principally to a volume unbalance, whereby the stabilities of such bows have been deficient.

Furthermore, when the moment of inertia is to be increased by merely increasing the weight, a construction of the handle riser section in which only wood, which has a relatively low specific gravity, is used results in an unreasonably large increase in the total volume whereby ease in handling and operating the bow is greatly impaired.

Accordingly, in order to increase the stability required of a bow, it is necessary to cause the center of gravity thereof to be as near as possible to the pivot point of the handle riser section when the bow is in its regular or normal position (*i.e.*, state of use) and to improve the moments of inertia with respect to the longitudinal and transverse axes intersecting at the center of gravity. For this purpose, the following expedients have heretofore been employed.

a. Increasing the volume of the material forming the bow around the longitudinal and transverse axes intersecting at the center of gravity of the bow. This method is frequently observed in conventional bows in which wood is used as the principal material.

b. Disposing a plurality of materials of the same kind but of different specific gravities or materials of two or more totally different kinds in specific positions. An example of the former is the method in which woods of timber species possessing different specific gravities or sapwood and heartwood having different specific gravities because of their compositions of the same species of timber are disposed in specific positions. An example of the latter is the method in which plastics of higher specific gravities than wood with, moreover, small fluctuations therein and materials such as metals are used in combinations.

Such conventional expedients as described above have been considered to be adequate for improving the stabilities of bows.

Wood, however, being a natural material, is originally nonuniform in composition and tends to have many defects and deficiencies in quality, and it is difficult to obtain bows made of wood having consistently uniform quality.

Furthermore, the range of selectability of combinations of volume and specific gravity is narrow as mentioned hereinbefore, and a particular difficulty is that of procuring woods of specific gravities over 1 (unity), which, even when available, are expensive.

On the other hand, plastics and metal materials have greater uniformity than woods and, higher specific gravities. However, when these materials are to be used as materials for forming the handle riser sections of bows, they must be formed into uniform shapes and require a higher degree of fabrication technique than woods, whereby the production cost is increased. Furthermore, these materials do not have the natural beauty of woods (*e.g.*, annual rings and grains).

SUMMARY OF THE INVENTION

The present invention contemplates overcoming the above-described difficulties experienced in the prior art.

It is a principal object of the invention to provide an archery bow in which the moments of inertia about the longitudinal and transverse axes intersecting at the center of gravity of the handle riser section are increased to maximum values without an unreasonable increase in the total body weight thereby increasing the moments of inertia of the bow assembly about the pivot point of the handle.

Another object of the invention is to provide a bow in which vibration due to the striking of the returning bowstring against the face of the upper and lower limbs at the time an arrow is projected and other irregular vibrations are absorbed as much as possible prior to such vibrations being transmitted to the pivot point of the handle for preventing a disturbance of the arrow projecting direction.

A further object of the invention is to provide a bow having a highly durable handle riser section which exhibits an aesthetically pleasing appearance equivalent to that of woods and, possesses uniform quality throughout.

The nature, principle and details of the invention will be more clearly apparent from the following detailed description with respect to preferred embodiments of the invention when read in conjunction with the accompanying drawing, in which like parts are designated by like reference numerals.

BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 is a left-side elevation showing in its entirety an example of a bow embodying the invention in an unstrung state;

FIGS. 2a, 2b, and 2c are respectively a back-surface elevation, a left-side elevation, and a face-surface elevation showing the handle riser section of the bow;

FIG. 3a is a left-side elevation showing still another example of the present bow;

FIG. 3b is a section taken along the plane indicated by line 3b-3b in FIG. 3a as viewed in the arrow direction; and

FIG. 3c is a section taken along the plane indicated by line 3c-3c in FIG. 3a as viewed in the arrow direction.

Since the principal purpose of FIGS. 2a-2c is to indicate the state of distribution of specific gravity, all lines unnecessary for this purpose have been deleted therein.

DETAILED DESCRIPTION

Referring to FIG. 1, the bow structure comprises essentially an upper limb 12, a lower limb 13, and a handle riser section 14 integrally and contiguously disposed between the upper and lower limbs. The outer (upper and lower as viewed in FIG. 1) ends of the limbs 12 and 13 are provided with bowstring notches or nocks 15 for anchoring end loops of a bowstring (not shown) when the bow is braced. The handle riser section 14 has, below its midpoint, a grip 17 at the upper and face side of which is formed a pivot point 18. The center of gravity of the bow is at a point 19 slightly above the pivot point 18 and slightly below an arrow rest 20. This organization is essentially the same as that of conventional bows. In the present bow, the handle riser section 14 is composed of WPC material (Wood Plastic Composite) or a combination of wood and WPC material of different specific gravities depending on the position.

One example of the laminated construction of a handle riser section according to the invention is shown in FIGS. 2a, 2b and 2c, in which materials of the same specific gravities are designated by the same reference numerals. The specific gravities of these various materials are as follows.

Reference numeral:	Specific gravity
1.....	1.0 to 1.1.
2.....	0.95 to 1.05.
3.....	0.9 to 1.0.
4.....	0.85 to 0.95.
5.....	0.8 to 0.9.
6.....	0.6 to 0.8.

In another example of a preferred embodiment of the invention as illustrated in FIGS. 3a, 3b, and 3c, the stabilities of the bow structure are increased by a distribution of materials as shown and having specific gravities as set forth in the following table.

Reference numeral:	Specific gravity
21 and 21a.....	1.0 or more.
22 and 22a.....	Do.
23.....	0.9 to 1.0
24.....	0.6 to 0.7.
25.....	0.8 to 0.9.

The aforementioned mass moments of inertia are considered about a longitudinal axis Y-Y and transverse axes X-X and Z-Z intersecting at a center of gravity 19a. In order to provide high values of these moments of inertia, the specific gravities of parts 21, 22, 21a, and 22a at the upper and lower ends of the handle riser section are of WPC material of the specific gravities indicated in the above table.

The WPC material constituting this handle riser section can be fabricated, for example, in the following manner.

Maple sapwood which has been dried to a moisture content of 8 percent is placed in an impregnator (vacuum chamber) in which the interior pressure is then lowered to 250 mm. Hg., and the sapwood is subjected to air evacuation for two hours. Separately, a solution is prepared by adding 1 part by weight of azobisisobutyronitrile (AIBN) as a catalyst and the combination of 0.36 part of Spiron Yellow, 0.36 part of Orazol Scarlet, 0.70 part of Fat Brown, and 0.09 part of Oil Black as coloring materials to 100 parts by weight of methacrylate monomer containing 50/1,000,000 part by weight of hydroquinone as an inhibitor.

Then, the solution thus prepared is introduced into the impregnator containing the maple sapwood after the above-described air evacuation treatment to steep the sapwood in the solution. Thereafter, the pressure within the impregnator is returned to atmospheric pressure, and the process materials are left in this state for 3 hours to cause the monomer mixture liquid to impregnate the wood.

Thereafter, the wood is unmoved from the impregnator and its surface covered with a material such as aluminum foil, vinyl chloride sheet, liquid paraffin, liquid gelatin, or liquid tar to prevent evaporation and escape of the monomer mixture. The wood thus covered is placed in a curing chamber and left for 4 hours in a hot draft at 70°C. to heat the monomers and cause polymerization thereof, whereupon a WPC material is obtained.

In another example, the solution may be prepared by adding the catalyst and the combination of the coloring material to a monomer mixture formed by blending 70 parts by weight of styrene with 30 parts by weight of acrylonitrile and containing 50/1,000,000 parts by weight of hydroquinone as an inhibitor. The process for the impregnation is exactly the same as that of

the first example with the exception that the curing time is 24 hours at 70°C.

This WPC material is essentially a wood material and has an external appearance which gives an impression of solidness and suitable weight and exhibits a beauty uniquely characteristic of wood materials, namely a bow material comparable to expensive woods such as, for example, ebony. These characteristics of bow materials are highly valued by archers and are, therefore, of high commercial importance.

Moreover, by varying the negative pressure of the degree of vacuum during the above-described air evacuation process, it is possible to adjust the degree of impregnation of the wood with the monomer mixture and to vary the specific gravity of the product over a wide range. For example, WPC materials of various specific gravities in a range of the order of from 0.6 to 1.1 can be readily produced. In an instance of actual practice of the above-described process embodying the invention, the specific gravity was 0.9.

As a result of experiments, the following effect of air evacuation pressure on monomer impregnation and specific gravity of the WPC material was obtained in the case of maple.

Pressure, mm. Hg:	Degree of monomer impregnation, percent	Specific gravity
600.....	20	0.80
375.....	30	0.85
250.....	40	0.90
100.....	50	0.95

Accordingly, the aforementioned methods *a* and *b* can be readily and logically put to practice through the use of these WPC materials. More specifically, by distributing WPC materials of preplanned specific gravities in logical dispositions such as to result in maximum mass moments of inertia about the longitudinal and transverse axes of the bow intersecting at the center of gravity thereof, it is possible to adjust the balance due to mass distribution without entailing an inordinate increase in the total body weight and total volume of the bow structure.

Thus, it is possible to prevent oscillation, angular movements, and translational movements in inconsistently irregular directions arising from an unbalanced mass distribution in the

handle riser section around the center of gravity as is observable in conventional bows of wood and to improve substantially the moments of inertia of the bow structure about the pivot point.

5 A further advantageous feature of a WPC material is that it has a greater capacity to absorb vibrations than a natural wood and does not readily transmit the vibrations of the upper and lower limbs to the pivot point, whereby the dynamic stability of bow structure at the time of projection is increased.

10 A further feature of a WPC material is that it is possible, by using low-priced woods, to obtain readily a material having an outer appearance and specific gravity comparable to those of expensive woods and yet retain the high workability of woods. Moreover, it is possible in a WPC material to eliminate the lack of homogeneity which has been the greatest disadvantage of natural woods and to provide a material of consistently homogeneous characteristics throughout, so that bows having identical quality and characteristics can be produced in large quantities.

20 Furthermore, in comparison with raw wood material, the WPC material produced therefrom has increased bending strength and affords a substantial increase in the durability of the resulting bow.

25 Basically, the present invention provide a bow construction of high static and dynamic stabilities, high durability, excellent external appearance, and consistently uniform quality which can be produced and reproduced at low cost and in large quantities.

I claim:

30 1. The handle riser section for an archery bow, said riser section being elongated in length and having a center portion and adjacent each end, a portion which is thicker than said center portion in a direction from the belly to the back of the riser section, each of said end portions being comprised of a plurality of wood laminations, and at least one of said wood laminations being impregnated with a synthetic resin having a specific gravity substantially greater than that of wood.

35 2. The handle riser section for an archery bow as claimed in claim 1 in which the wood is degasified, steeped in a solution comprising at least one monomer, at least one coloring material and a catalyst, and heated to effect polymerization of the monomer content of the solution.

40 3. The handle riser section for an archery bow as claimed in claim 1 in which the center portion is defined by a plurality of wood laminations impregnated with a synthetic resin having a specific gravity substantially greater than that of wood and less than that of the resin impregnating said at least one wood lamination.

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