Dec. 29, 1953 H. F. LAKE 2,664,079

METAL ARCHER'S BOW

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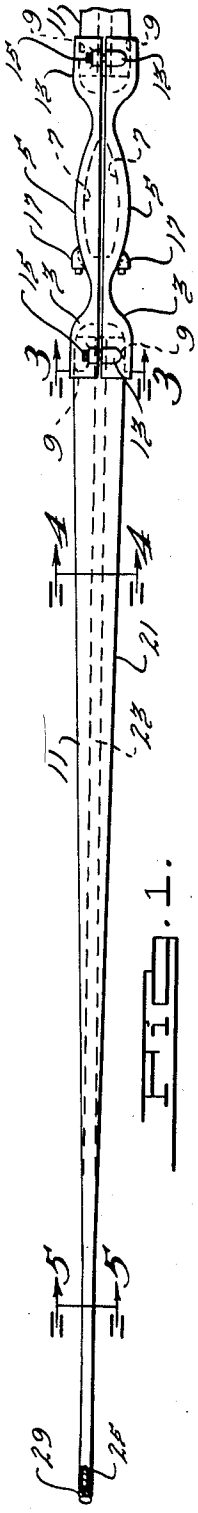


FIG. 1.

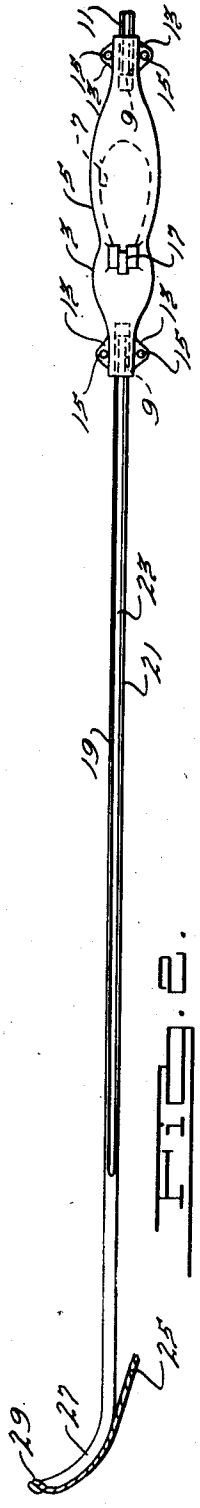


FIG. 2.

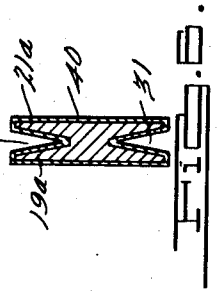


FIG. 6.

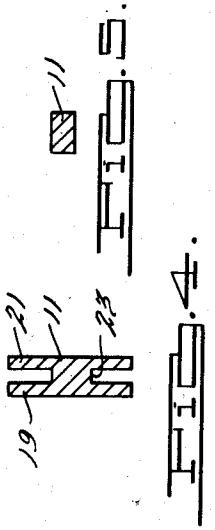


FIG. 5.

FIG. 4.

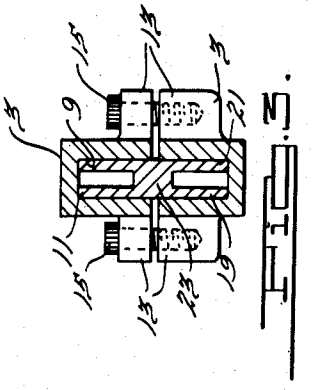


FIG. 3.

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METAL ARCHER'S BOW

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6 Claims. (Cl. 124—24)

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This invention relates to the art of archery and in particular refers to archers' bows.

In recent years attempts have been made to provide a metal bow to replace the traditional wooden bows in the field of archery. These were made in recognition of a number of advantages of a bow constructed of metal, among them being that the metal bow is less expensive to manufacture, has a longer life, is relatively unaffected by atmospheric variations, particularly changes in humidity, and it can be easily made in separable sections that can be taken down to form a compact bundle. The wooden bow, however, has been superior in one important respect to any of the metal bows that have been available heretofore and in consequence of this has retained its dominant position in the field. This is in vibration characteristics, the wood possessing a high damping capacity so that there is relatively little vibration upon release of the taut bowstring. Metal bows of prior construction have been subject to excessive vibration of this sort and these are transmitted, of course, to the arm and shoulder muscles and quickly tire many archers. Consequently, prior to the present bow, metal bows had not received widespread approval in the art. These vibrations also result in fatigue failures of the bow limbs which, if eliminated, would result in a bow life that would be virtually limitless. Prior metal bows have been peculiarly subject to failures of this type.

In bows constructed according to the principles of the present invention, harmful vibrations are substantially eliminated. This is the result of two features in particular which are embodied in the limbs of the bow. The first of these is a highly efficient limb shape in which substantially all unnecessary metal is eliminated. Thus, there is less accelerated mass to create vibrations, and, incidentally, less kick of the bow as well as a quicker bow reaction, the latter resulting in a greater cast of the arrow than heretofore obtained. The second feature comprises damping means which is operatively connected to the bow limbs and is effective to attenuate incipient vibration.

An archer's bow embodying these features in a preferred manner is shown by way of illustration but not of specific limitation in the accompanying drawings in which:

Fig. 1 is a plan or front elevation of the bow with a part of a limb broken away;

Fig. 2 is a side elevation of the bow;

Figs. 3, 4 and 5 are sections taken on lines 3—3, 4—4, and 5—5, respectively, of Fig. 1; and,

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Fig. 6 is a section of a modified form of limb as might be taken on line 4—4 of Fig. 1.

The improved bow may have a handle of any desired construction. Preferably, however, the bow is separable and may be taken down to facilitate transportation thereof and a suggested form of combined handle and connecting means for the limbs is shown in the drawings. This handle, for ease in manufacture, may comprise identical mating sections 3, which are surface contoured at 5 to fit the hand an internally hollowed at 7 to reduce the weight thereof. The sections 3 have rectangular end semi-recesses 9 which in cooperation provide rectangular recesses for receiving the inner ends of the limbs 11. The handle sections 3 have lateral lugs 13 adjacent the recesses and these may be provided with screw-type connecting means 15 whereby the sections 3 may be tightly drawn together to securely clamp the limbs 11 in the recesses 9. Arrow rests of a suitable type may also be attached to the handle sections 3 as shown at 17.

The limbs 11 of the present bow have a cross section over at least a substantial part of their lengths which is generally described by the terms I or H sections, the latter term being employed herein. Thus, the limb has a cross section comprising front and rear flanges 19 and 21 joined by a web 23 which lies substantially in the common plane of bending of the bowstring 25. The bowstring is secured to the forwardly bent outer ends 27 of the limbs 11 in a known manner as shown at 29.

In the preferred embodiment of Fig. 4, the flanges 19 and 21 are each of uniform thickness; however, as shown in the modification of Fig. 6 wherein the flanges 19a and 21a are separated by a V-shaped grooves 31, they may be of non-uniform thickness. The limbs are tapered outwardly in general accord with the decrease in stress and, if desired, the outermost sections may be square or rectangular as shown in Fig. 5.

It will be recognized that the general effect of the novel limb cross section shown is to give maximum strength in bending with minimum inertia forces, i. e., a maximum bow efficiency. The inertia is, of course, reduced by eliminating material on the limb sections which are only lightly stressed by bending forces. Thus, in the end sections the limb may be rectangular as shown since very little saving in weight would be achieved by eliminating the material adjacent the neutral plane thereof. The reduction in weight or inertia over prior limb designs gives a quicker start on release of the arrow by the

archer and reduces the inertia forces after the arrow has left the bowstring. This, it will be recognized, is accomplished with no sacrifice in the operative qualities of the bow. It is the inertia forces in the bow upon release of the stressed bowstring which cause the kick and vibrations that are troublesome to the archer and by reducing them the bow is made much easier to handle.

When the bowstring **25** is stressed and the limb bent rearwardly, the flange **19** is in tension and the flange **21** in compression with the neutral plane lying, preferably, somewhere in the web **23**. Upon release of the bowstring, the limbs spring forward and due to their inertia carry beyond their original unstressed position of Fig. 2 to an extent which is dependent upon the magnitude of the inertia forces, and this movement results in a reversal of stress in the flanges to an extent which is also dependent upon the damping capacity of the material of which the limb is constructed. I have found that it is possible to so greatly minimize inertia forces in the bow as to eliminate objectionable vibration, while also increasing the efficiency of the bow. These desirable results are accomplished by employing a cross section having a minimum of inactive material, and also by using a limb material having a high strength-weight ratio and a high damping capacity. The wrought aluminum alloys have proven satisfactory in these respects, the alloy known in the trade as "75ST" being, at present, the preferred composition. If such material, or other metals, are used, the limbs are preferably formed by longitudinal rolling or extrusion since this imparts a desired grain elongation and other beneficial microstructural characteristics to the metal.

In addition to the foregoing consideration it should also be observed that the flanges **19** and **21** need not necessarily be of either the same thickness or width, i. e., area. As is known, metals behave differently under pure tension than they do under substantially pure compression and are subject to failure at lower values of tensile stresses than compression stresses. Thus, in the present design, the flange **21**, being subject primarily to compression may be of a lesser area but higher unit stress than the flange **19**. This consideration, however, is to be tempered by the fact that the flanges are subject to both tension and compression, i. e., to alternating stresses and fatigue so that the area of flange **21** should also be sufficient to withstand the tensile stress thereon, the relative value of which is determined by the rate at which the vibrations or oscillations of the limbs are damped by the material of which they are composed or by other means which may be employed for the purpose of increasing damping.

In the latter regard, surface coatings of rubber or metal of a low yield point (such as pure aluminum or "Alclad" coats on the 75ST mentioned) increase the fatigue resistance of metal limbs and it is believed that this is due to their effect in increasing the rate of damping. These coatings may be applied by methods and in thicknesses which are readily determinable by those in the art, about a three thousandths of an inch skin being satisfactory as an average value. The fatigue resistance of the bow may also be improved by known methods of surface prestressing. With the present cross sections, the damping

coatings **40** (Fig. 6) or prestressing can be applied to either or both of the outer surfaces of the flanges **19** and **21** or if desired to the entire limb surface, although I have found that coating the outer surface is of primary importance. The damping coatings need not and, in fact, preferably are not, integrated into the microstructure of the limb material; they serve their purpose so long as they are subject to the variation in stress. For example, a decarburized layer on a steel limb is not as desirable as a layer applied by electrical or spray means since it is likely to initiate fatigue failures which will be easily propagated into the body of the limb. In the case of the nonintegrated coatings such as rubber, or electroplated material, there is a plane of demarcation to prevent propagation of cracks, and the plane of demarcation seems to be adequate for this purpose also in the case of the "Alclad" and pure aluminum coatings.

While a specific form of the invention has been shown, it will be apparent that it is capable of various modifications without departing from the spirit and scope thereof.

What is claimed is:

1. In a bow, a tapered aluminum alloy limb having cross sections along all of its length except the outer end portion thereof which each comprises spaced transverse portions having straight edges defining the front and rear faces of the limb with the major dimension of said portions being tranverse to the direction of flexure of the limb and an integral web of substantially less transverse thickness connecting the portions, said outer end portion cross sections being of substantially uniform thickness and adapted to anchor one end of a bowstring.

2. The invention set forth in claim 1 wherein said limb is covered with a layer of damping material.

3. The invention set forth in claim 2 wherein said material is rubber.

4. The invention set forth in claim 2 wherein said material is substantially pure aluminum.

5. The invention set forth in claim 1 wherein said limb is extruded.

6. The invention set forth in claim 1 wherein said limb is rolled longitudinally.

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