

Dec. 30, 1969

H. W. ALLEN

3,486,495

ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS

Filed June 23, 1966

2 Sheets-Sheet 1

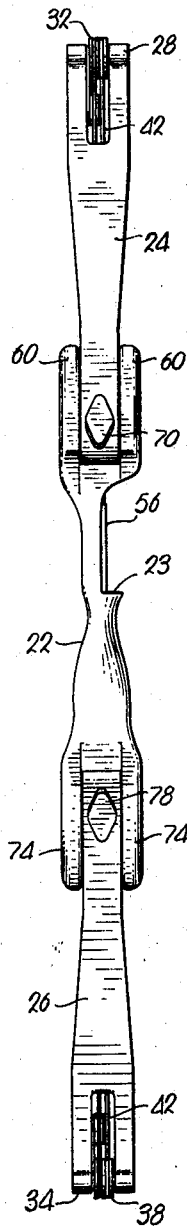


Fig. 2.

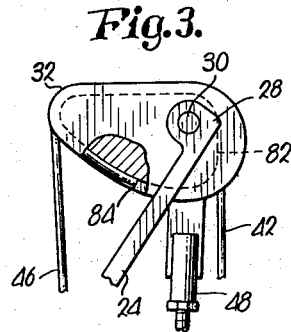


Fig. 3.

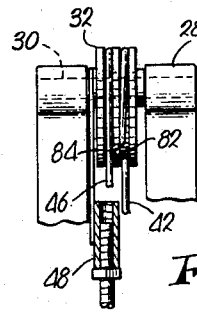


Fig. 4.

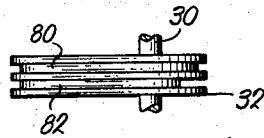


Fig. 5.

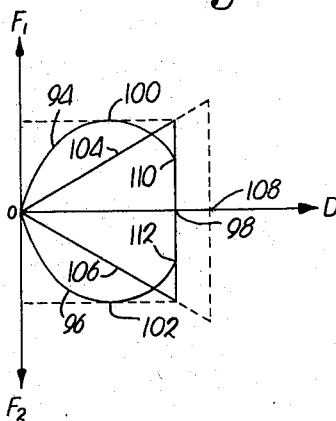


Fig. 9.

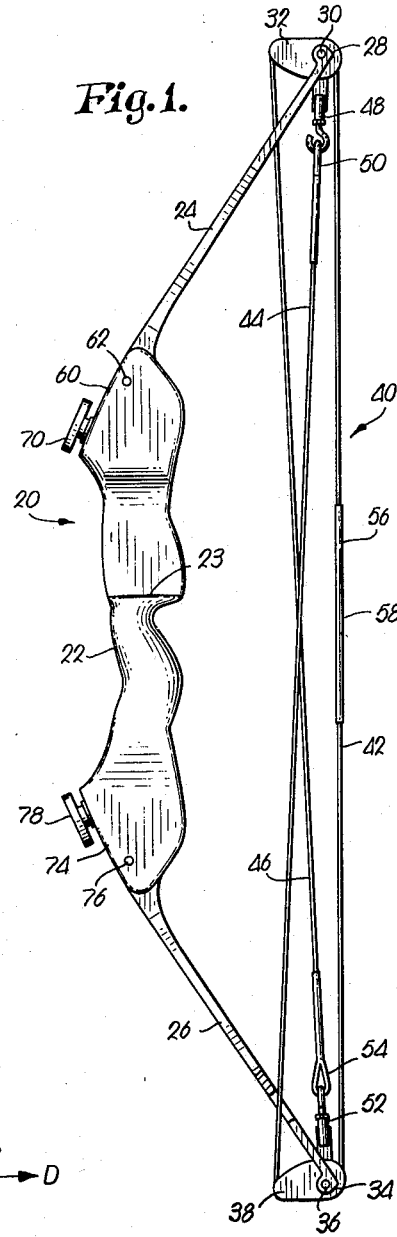


Fig. 1.

INVENTOR
Holless W. Allen

BY
Novey, Schmidt, Johnson & Novey
ATTORNEYS.

Dec. 30, 1969

H. W. ALLEN

3,486,495

ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS

Filed June 23, 1966

2 Sheets-Sheet 2

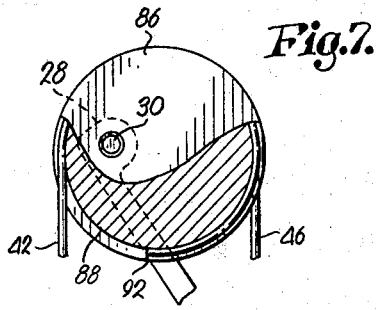


Fig. 7.

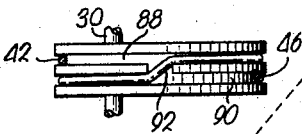


Fig. 8.

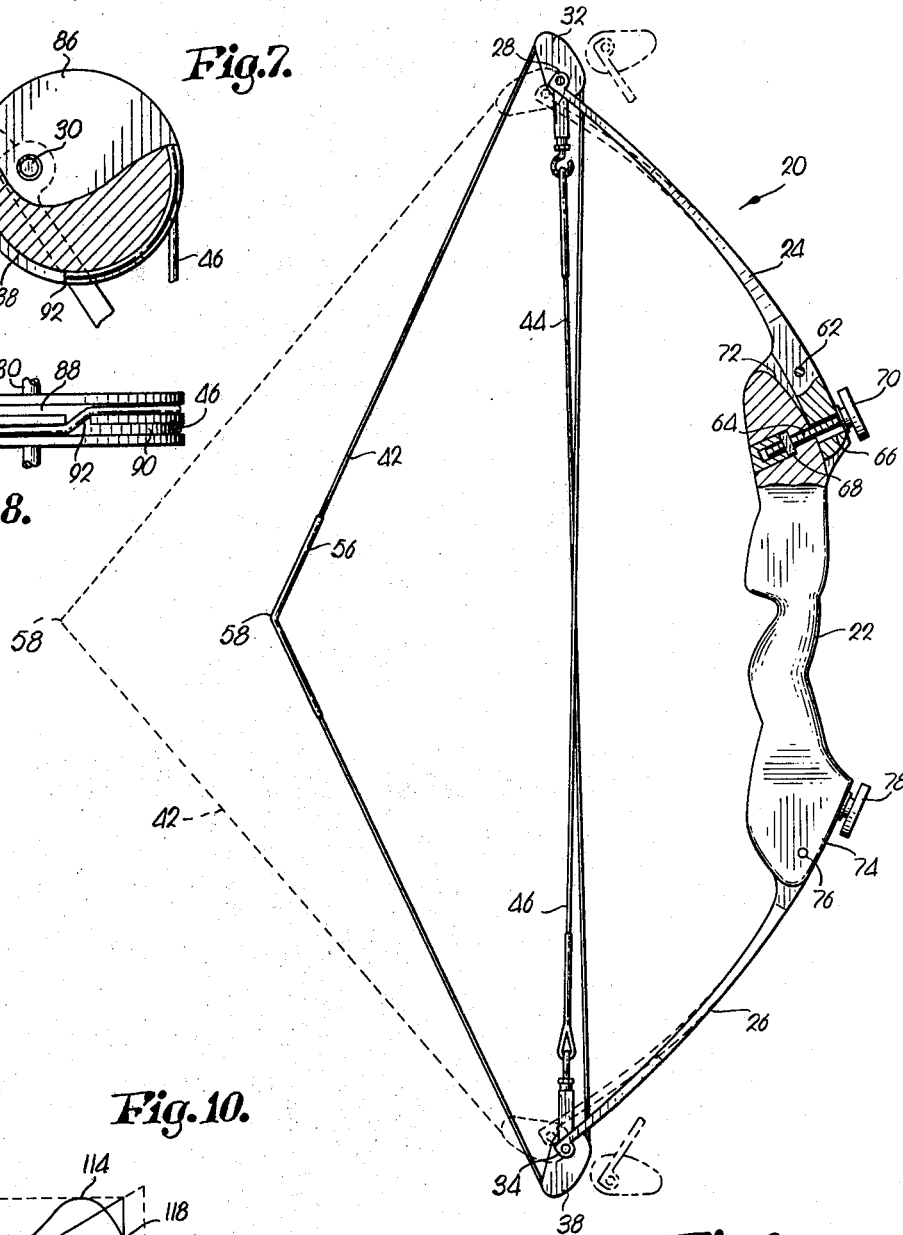


Fig. 6.

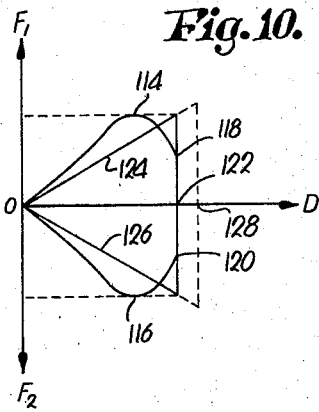


Fig. 10.

INVENTOR
Holless W. Allen

BY

Bovey, Schmidt, Johnson & Hovey
ATTORNEYS.

1

3,486,495
**ARCHERY BOW WITH DRAW FORCE
 MULTIPLYING ATTACHMENTS**
 Holless W. Allen, Kansas City, Mo.
 (Billings, Mo. 65610)
 Filed June 23, 1966, Ser. No. 559,761
 Int. Cl. F41b 5/00

U.S. Cl. 124—24

14 Claims

ABSTRACT OF THE DISCLOSURE

An archery bow having rotatable, variable leverage pulley members on the tips of the bow limbs. A bowstring is wound over the members to provide mechanical advantage, and less force is required to hold the bowstring in a fully drawn position than to hold the bowstring at an intermediate draw position.

This invention relates to improvements in shooting bows and, more specifically, to a bow having variable purchase devices mounted on the limb tips thereof and operable by the bowstring to increase the energy of the bow when drawn without increasing the length of the draw or the holding force required in the drawn position.

Shooting bows in widespread use at the present time are available in a number of different types and configurations; however, the archer's bow has not changed in basic design since the development of the long bow many centuries ago. Although a number of refinements have improved the efficiency of the modern bow as compared with its historical predecessor, the essential shooting characteristics remain the same in that the force required to draw the bowstring increases as the limbs are flexed to a maximum level at full draw. Thus, the maximum pull is required when the archer sets for the shot, thereby limiting the strength of the bow which may be handled by a particular individual since an archer must be capable of holding the bow on target while simultaneously exerting maximum pull on the bowstring.

Another important limitation in present bow design is the maximum energy which may be stored in the limbs. The bow must be shot after the nocking point is moved a fixed distance, referred to as the standard draw, regardless of the strength of the bow. Therefore, in order to increase the energy of the bow, the limbs are stiffened to require a greater pull at the standard draw. Manifestly, here again, the physical capabilities of the archer are controlling.

It is, therefore, the primary object of this invention to increase arrow speed and impact by providing a bow which, for a given strength, is capable of storing greater energy when drawn without requiring that the maximum pull weight of the bow be increased.

It is also an important object to provide a bow having a lesser pull weight at full draw than at an intermediate drawn position, so that the maximum force applied by the archer to the bowstring will not be required to hold the string in the fully drawn position.

Another important object is to provide a bow having variable purchase devices on the limbs thereof which transmit the force applied to the bowstring to the limb tips as the bowstring is drawn, such devices serving to require the archer to apply added force at the commencement of the draw to effect an increased energy buildup in the limbs so that, at full draw, greater energy will be imparted to the limbs although a lesser force is required to hold the string.

2

Still another important object is to provide a bow which, by virtue of the force and energy characteristics referred to above, will shoot an arrow by the application of force thereto which does not reach a maximum until after the released bowstring has traveled a distance toward its rest position so that improved flight characteristics will be imparted to the arrow.

Furthermore, it is a specific object to provide a bow having an energy graph characteristic which is generally ellipsoidal in configuration, rather than triangular as in conventional bows so that, for limbs of a given stiffness, greater limb tip travel, and hence increased energy, will be obtained for a standard draw.

Additionally, it is an aim of this invention to provide limbs which are adjustable with respect to the handle section of the bow in order to permit relaxing of the limbs during nonuse and adjustment of the pull weight of the bow.

In the drawings:

FIGURE 1 is a side elevational view of the bow;

FIG. 2 is a front view of the bow;

FIG. 3 is a detail of the eccentric member on the upper limb of the bow as seen in FIG. 1;

FIG. 4 is a front view of the structure shown in FIG. 3;

FIG. 5 is a detail, plan view of the member shown in FIG. 3;

FIG. 6 is a side elevational view of the bow taken from the opposite side as compared with FIG. 1, and showing the intermediate and drawn positions of the bowstring;

FIG. 7 is a side elevational, detail view of a modified form of the eccentric member;

FIG. 8 is a bottom view of the structure shown in FIG. 7;

FIG. 9 is a graph illustrating the characteristics of the bow utilizing the eccentric members illustrated in FIGS. 1-6; and

FIG. 10 is a graph illustrating the operation of the bow utilizing the modified eccentric members illustrated in FIGS. 7 and 8.

A bow 20 is provided with a riser or handle section 22 having an arrow shelf 23 and a pair of upper and lower limbs 24 and 26 respectively, extending outwardly therefrom. Upper limb 24 has a tip 28 which is bifurcated as illustrated in FIG. 2 and mounts a cross pin 30 upon which an eccentric pulley member 32 is rotatably mounted. Similarly, lower limb 26 has a bifurcated tip 24 which carries a cross pin 36 upon which a pulley member 38 is eccentrically mounted.

A bowstring 40 is trained around members 32 and 38 to present a central stretch 42 and a pair of end stretches 44 and 46. An adjustable coupling 48 connects the end 50 of stretch 44 to tip 28 at cross pin 30, an adjustable coupling 52 connecting end 54 of stretch 46 to tip 34 at cross pin 36. The central, outer stretch 42 is provided with a serving 56 which presents the nocking point 58 of the bowstring.

The upper portion of handle section 22 is configured to present a pair of parallel side members 60 which define a channel therebetween receiving the lower end portion of limb 24. A pivot pin 62 extends through members 60 and limb 24 and mounts the latter for swinging movement about the axis of the pin. A threaded shank 64 (FIG. 6) extends through an opening 66 in the lower end of limb 24 and is held by a nut 68 recessed into handle section 22 as illustrated. An adjustment knob 70 is rigid with the outer end of shank 64, the base of the channel formed by side members 60 being arcuate in configuration as indicated at 72 in FIG. 6. In like fashion, the upper end of

lower limb 26 is received between the lower side members 74 for swinging movement about a pivot pin 76 upon rotation of knob 78.

Member 32 is of generally oval-shaped configuration and is grooved (see FIG. 5) to present a pair of parallel bowstring tracks 80 and 82 which traverse a generally oval-shaped course. Track 82 at the right-hand edge of member 32 (as viewed in FIGS. 1, 3 and 5) is more deeply recessed into the periphery of the member than track 80, and thus is shorter in length. Stretch 46, when the bow is at rest as shown in FIGS. 1-4, contacts track 80 at the left end of member 32 (as viewed in FIGS. 3 and 5), and then the bowstring makes approximately a two-thirds wrap before crossing over to track 82. Then, the bowstring follows track 82 for approximately a three-quarter wrap and emanates from device 32 to present central stretch 42. Crossover of the bowstring from track 82 to track 80 is permitted by a notch 84 in the periphery of member 32 which intercommunicates the two tracks.

Member 38 is identical in construction to member 32 except that the tracks therein are reversed with respect to the showing of FIG. 5 to dispose the shorter track of member 38 in the same plane as track 82 of member 32, and the longer track thereof in the same plane as track 80. This is necessary to properly align the tracks since the lower member 38 is inverted with respect to upper member 32. Except for the direction of wrap, the bowstring is received by member 38 in the same manner as member 32 with central stretch 42 emanating from the shorter track.

FIGS. 7 and 8 illustrate a modified pulley member 86 of circular configuration rotatable on the pin 30 carried by tip 28. The circumferential periphery of member 86 is grooved to provide two circular, parallel bowstring tracks 88 and 90 of equal length. The bowstring is wrapped around member 86 one and one-half times with a crossover at notch 92. Member 86 is used in conjunction with a lower eccentric pulley member (not shown) of identical configuration, such pulley members being substituted for members 32 and 38 in the modified form of the invention. When the bow is at rest, notch 92 is disposed as shown at the lowermost point of member 86; conversely, however, the crossover point for the lower member would be at the uppermost point on its circumferential periphery when the bow is at rest. In all respects, therefore, except for the track configuration, the circular pulley members are employed in the same manner as members 32 and 38.

FIGURE 9 illustrates the operation of the bow using the eccentric members illustrated in FIGS. 1-6. The x axis of the graph is labeled D and plots the distance that nocking point 58 is drawn. The force applied to nocking point 58 by the archer is divided into two components F_1 and F_2 which are identical in magnitude at any distance D. F_1 represents the force required to flex limb 24, while force F_2 represents the force required to flex limb 26.

Curves 94 and 96 begin at the origin and terminate at a draw distance designated 98. This distance 98 represents a standard draw illustrated in FIG. 6 by the broken line representation of central stretch 42. The two curves 94 and 96 reach coordinates representing maximum force at points 100 and 102, respectively. It will be appreciated, therefore, that the area enclosed by curves 94 and 96 is ellipsoidal in configuration and represents the total energy stored in limbs 24 and 26 at a standard draw.

Lines 104 and 106 emanating from the origin represent the energy diagram produced by a conventional bow utilizing a bowstring directly joined at its ends to the limb tips. It will be appreciated that, at a standard draw, the triangle defined by lines 104 and 106 and the interconnecting line through point 98, is of less area than the aforementioned area between curves 94 and 96. In order to reach an equivalent energy level, the draw would have to be increased to a distance 108 as illustrated by the broken line projection of lines 104 and 106.

At this juncture, it is instructive to note that the energy

stored in the bow at a standard draw is greater than in a conventional bow and, furthermore, that the force required to hold the bowstring at full draw is both less than the maximum pull 100, 102 and appreciably less than the pull weight of a conventional bow, which would also be equal to 100, 102. This holding force at full draw is represented by the ordinates terminating at 110 and 112; thus, FIG. 9 vividly illustrates that, for a substantially decreased pull weight at full draw, the bow of the instant invention yields greater power through increased energy storage in limbs 24 and 26, such energy being imparted by the archer during movement of nocking point 58 from the rest position (shown in FIG. 1) to the drawn position illustrated in FIG. 6.

The full lines in FIG. 6 show nocking point 58 in its intermediate position where the drawing force or pull is represented in FIG. 9 by the points 100, 102. During the draw from the rest position to such intermediate position, members 32 and 38 rotate about pins 30 and 36 as illustrated with member 32 rotating in a counterclockwise direction and member 38 rotating in a clockwise direction, as viewed in FIG. 6. In effect, therefore, the portions of the eccentric members of longer radius swing outwardly and rearwardly toward the archer during this first portion of the draw from the rest to the intermediate position.

The tension of bowstring 40 in cooperation with the crossover notches in members 32 and 38 prevents slippage of the bowstring in the tracks formed in members 30 and 32. Thus, the members are forced to traverse the paths illustrated and are effective to increase the force required to draw the bow during this initial displacement of nocking point 58. This additional force is converted into increased displacement of limb tips 28 and 34.

As the archer continues to draw the bow and shifts nocking point 58 to the drawn position illustrated in broken lines, member 32 and 38 effect a gain in mechanical advantage and permit easier drawing of the bow. This is illustrated by a comparison of the full and broken line positions of the members in FIG. 6 where it may be seen that both members continue rotation until their longest radii point in the general direction of the archer. The leverage obtained is by virtue of the length of each member from its axis of rotation to the end thereof remote from the axis to which central stretch 42 is effectively connected after the nocking point is drawn to the intermediate position. It will be noted that initially when the bow is at rest, end stretches 44 and 46 of the bowstring emanate from the remote end portions of members 32 and 38, while after the intermediate position is reached, central stretch 42 emanates from such remote ends.

The effect produced as the archer draws the bow is perhaps best visualized with reference to curves 94 and 96 of FIG. 9. At the outset of the draw the ordinate values of the curves increase quite rapidly and thus exhibit that the required drawing force must be progressively increased to shift the nocking point 58 from the rest position to the intermediate position represented by points 100 and 102. As the intermediate position is approached, the required force increases less rapidly until the maximum is reached at points 100 and 102. After the intermediate position, as the nocking point is shifted to the drawn position, the required applied force progressively decreases to a value represented by ordinates 110 and 112, the holding force at standard draw.

FIGURE 10 illustrates the operation of the bow utilizing the eccentric members shown in FIGS. 7 and 8. The operation is essentially the same as described above, but the energy diagram produced differs in that a more linear force increase is produced between the rest and the intermediate or maximum force position of nocking point 58 illustrated at points 114 and 116 on the graph. Here again, however, the holding force at full draw illustrated at 118 and 120 is substantially less than for a conventional bow, and the energy imparted to the limbs is greater at the standard draw distance 122. Lines 124

5

and 126 represent the draw of a conventional bow, which would have to be extended to a distance represented by point 128 in order to impart the same energy to the limbs as produced by the instant invention at the standard draw.

Although the addition of the eccentric pulley members to the limb tips necessarily increases the mass and therefore the inertia of the limbs, this is more than offset by the use of shorter limbs of increased strength or stiffness. Limbs of approximately three times the strength of conventional bow limbs are preferred. This results in a corresponding reduction of limb tip travel required for a given amount of bow energy. The three line lacing of the bowstring provides a 3:1 mechanical advantage (ideally) and, in cooperation with the eccentric pulleys, enables the archer to flex the limbs and draw the bowstring to the standard draw.

Relaxing of the limbs during nonuse is facilitated by adjustment knobs 70 and 78 which may be rotated to release the limbs for swinging movement about pivot pins 62 and 76. Additionally, knobs 70 and 78 provide a means of adjusting the pull weight of the bow to suit the individual archer. In FIG. 6 it may be seen that limb 24 is illustrated in a position requiring maximum pull since the lower end thereof is flush with base surface 72. To reduce the pull weight, shank 64 is rotated in a direction to permit counterclockwise displacement of limb 24 about pin 62 (as viewed in FIG. 6) to allow the lower end of the limb to move away from surface 72 to a desired degree.

Having thus described the invention, what is claimed as new and desired to be secured by Letters Patent is:

1. In a shooting bow:

a handle section provided with a pair of outwardly extending resilient limbs presenting a pair of spaced limb tips;

a bowstring having a nocking point; and structure coupling said bowstring with said tips for movement of said point from a rest position to a drawn, limb-flexing position upon application of drawing force thereto,

said structure having means for establishing an intermediate position of said point between said rest and drawn positions where the applied force required to hold the point in said intermediate position is greater than the force required to hold the point in the drawn position, whereby to increase the rate of buildup of energy in the bow between the rest position of the point and the intermediate draw position while also decreasing the holding force at full draw to a value less than the force at intermediate draw.

2. The invention of claim 1, said means varying the ratio of applied force to the corresponding displacement of the point as the latter is shifted from the rest position to the drawn position.

3. The invention of claim 1, said means permitting movement of said point to the drawn position by the application of forces of continuously decreasing magnitude after the point reaches said intermediate position and until it reaches the drawn position.

4. The invention of claim 1, said means, during initial movement of said point away from the rest position, effecting flexure of said limbs in response to applied forces of relatively rapidly increasing magnitude, and subsequently permitting movement of said point from the intermediate position to the drawn position by the application of forces of continuously decreasing magnitude.

5. The invention of claim 4, said means, during movement of said point from the rest position to the intermediate position, effecting flexure of said limbs in response to applied forces

6

of continuously less rapidly increasing magnitude as the point approaches the intermediate position.

6. The invention of claim 1, said means including a pair of variable purchase devices operable associated with respective limbs, said bowstring being connected to said devices for operating the latter to flex the limbs as the point is shifted from the rest position to the drawn position.

7. The invention of claim 1, said means including a pair of variable leverage components rotatably mounted on respective tips, said bowstring being connected to said variable leverage components for shifting each of the latter through a first, tip travel increasing angular displacement during movement of said point from the rest position to said intermediate position, and through a second, mechanical advantage gaining angular displacement as the point is shifted from the intermediate position to the drawn position.

8. The invention of claim 7, each of said variable leverage components comprising an eccentric member, the axes of rotation of the members being in parallelism and extending transversely of the direction of flexure of said limbs,

said bowstring having a pair of ends and being trained around said members to present a central stretch and a pair of end stretches extending between the limbs, whereby the bowstring is wrapped around each member,

said coupling structure further including means fastening the ends of the bowstring to respective limbs, said members being provided with means preventing slippage of the bowstring thereon, said central stretch presenting said point.

9. The invention of claim 8, each of said members having a bowstring engaging track of generally oval-shaped configuration disposed in eccentric relationship to the axis of rotation thereof.

10. The invention of claim 8, each of said members having a bowstring engaging track of circular configuration disposed in eccentric relationship to the axis of rotation thereof.

11. The invention of claim 1, said handle section having a pair of pivots supporting respective limbs remote from said tips thereof for swinging movement of each limb along a path of travel extending rearwardly of the section; and adjustable means interconnecting said limbs and said section for releasably securing the same together with the limbs disposed in selected positions relative to said section, whereby to permit relaxing of the limb during nonuse and adjustment of the pull weight of the bow.

12. In a shooting bow: a handle section provided with a pair of outwardly extending, resilient limbs presenting a pair of spaced limb tips;

a bowstring having a nocking point;

a guide for said bowstring on each of said tips respectively,

said bowstring having a central stretch spanning said guides and provided with said point, and further having a pair of end stretches,

each of said end stretches extending across the limbs from a corresponding guide to the opposite limb; and

means fastening said end stretches to the bow at their terminations.

13. The invention of claim 12, each of said end stretches diverging from the limb proximal to the corresponding guide as the opposite limb is approached.

14. The invention of claim 1,
 said means including a pair of rotatable, variable
 leverage components operably associated with re-
 spective limbs,
 said bowstring being connected to said components for
 shifting each of the latter through a first angular
 displacement increasing the travel of the respective
 tip during movement of said point from the rest
 position to said intermediate position, and through
 a second, mechanical advantage gaining angular dis-
 placement as the point is shifted from the inter-
 mediate position to the drawn position.

5

10

References Cited

UNITED STATES PATENTS

85,874	1/1869	Tilden -----	124—24
261,610	7/1882	Howe -----	124—23
2,307,021	1/1943	Cordrey et al. -----	124—23
2,957,470	10/1960	Barna -----	124—24
3,207,146	9/1965	Grable -----	124—24

RICHARD C. PINKHAM, Primary Examiner

WILLIAM R. BROWNE, Assistant Examiner

Disclaimer

3,486,495.—*Holless W. Allen*, Kansas City, Mo. ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS. Patent dated Dec. 30, 1969. Disclaimer filed June 18, 1974, by the assignee, *Allen Archery, Inc.*

Hereby enters this disclaimer to claims 1, 2 and 11 of said patent.
[*Official Gazette May 20, 1975.*]

Disclaimer

3,486,495.—*Holless W. Allen*, Kansas City, Mo. ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS. Patent dated Dec. 30, 1969. Disclaimer filed June 3, 1983, by the assignee, *Allen Archery, Inc.*

Hereby enters this disclaimer to claims 3, 4, 5, 6, 12 and 13 of said patent.
[*Official Gazette October 11, 1983.*]