Dec. 30, 1969 H. W. ALLEN 3,486,495

ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS

Filed June 23, 1966 2 Sheets-Sheet 1

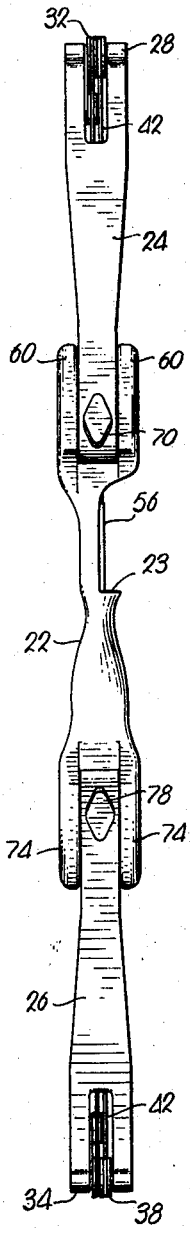
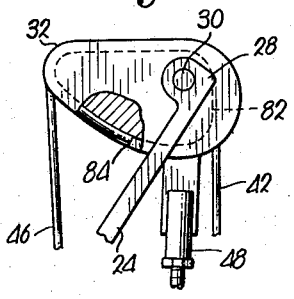


Fig.2.

Fig.3.



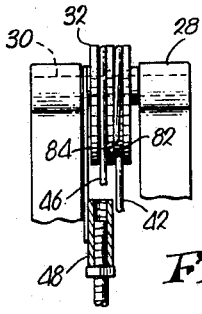


Fig.4.

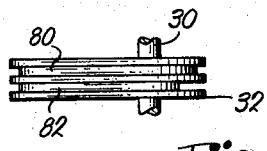


Fig.5.

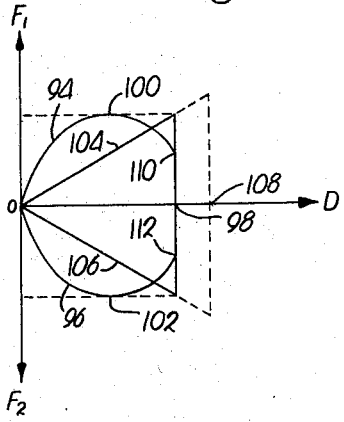
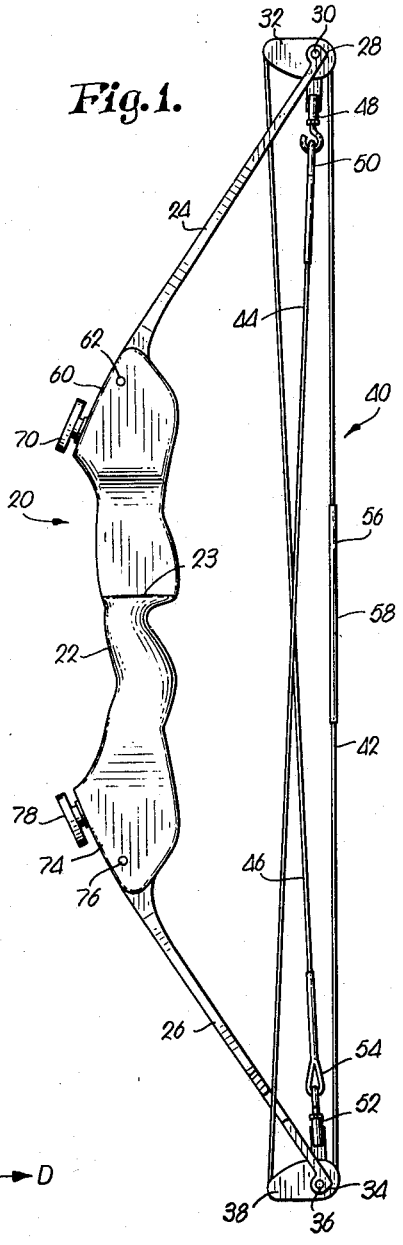


Fig.9.

Fig.1.



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ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS

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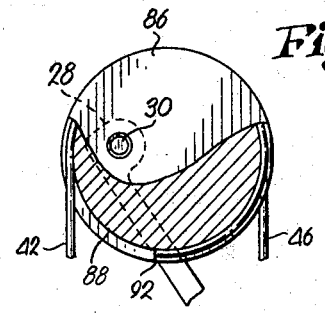

Fig.7.

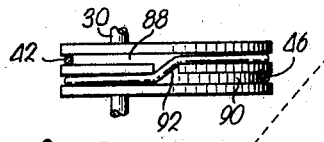

Fig.8.

Fig.6.

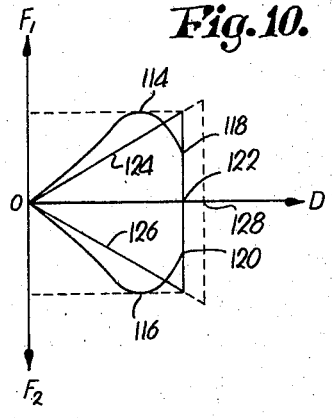

Fig.10.

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ARCHERY BOW WITH DRAW FORCE MULTIPLYING ATTACHMENTS

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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 positon.

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 ceturies ago. Although a number of refinements have improved the efficiency of the modern bow as compared with its historical predecessor, the essential shotting 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 limting 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 capabilites of the archer are controlling.

It is, therefore, the primary object of this invention to increase arrow speed and imapct 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.

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 detaile 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-band 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 as 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 reqired 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 leess 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**

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 incerases 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 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 respective 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 displacement as the point is shifted from the intermediate position to the drawn position.

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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.*]