United States Patent [19]

Hunter

[11] **3,841,295**

[45] **Oct. 15, 1974**

[54] **COMPOUND ARCHERY BOW**

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[73] Assignee: **Donald S. Kudlacek,** Longview, Wash.

[22] Filed: **Aug. 20, 1973**

[21] Appl. No.: **390,106**

[52] **U.S. Cl.** ..... **124/24 R,** 124/30 A, 124/30 R

[51] **Int. Cl.** **F41b 5/00**

[58] **Field of Search** .... 124/24 R, 23 R, 30 A, 30 B, 124/30 R

[56] **References Cited**

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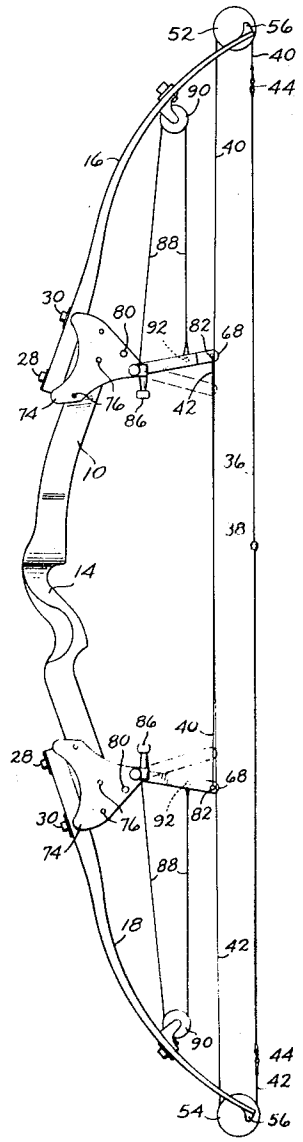
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Primary Examiner—Richard C. Pinkham
Assistant Examiner—William R. Browne
Attorney, Agent, or Firm—Oliver D. Olson

[57] **ABSTRACT**

An archery bow string is secured intermediate its ends to eccentrically pivoted cams mounted at the outer ends of the limbs of a bow. An adjustable control cable operatively interconnects each limb, inwardly of the associated cam, and a lever mounted pivotally on the bow inwardly of said limb connection. The terminal end of each end segment of the bow string is secured to the lever associated with the opposite limb, outwardly of the control cable connection to said lever, in order to balance a maximum pull weight which remains constant throughout a predetermined intermediate portion of the draw length. Adjustment of the length of the control cables effects adjustment of the tension and flexure of the limbs, pull weight of the bow string, angular position of the cams. A coupling member is used to connect a working stretch portion of a bow string with its end segments.

8 Claims, 10 Drawing Figures



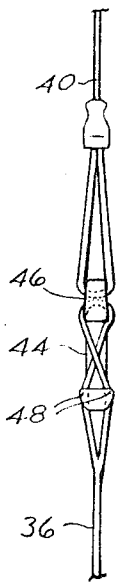


Fig. 3.

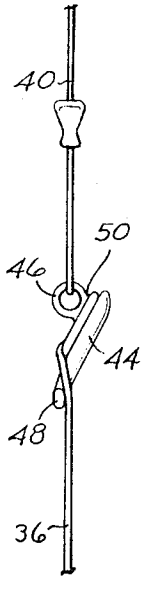


Fig. 4.

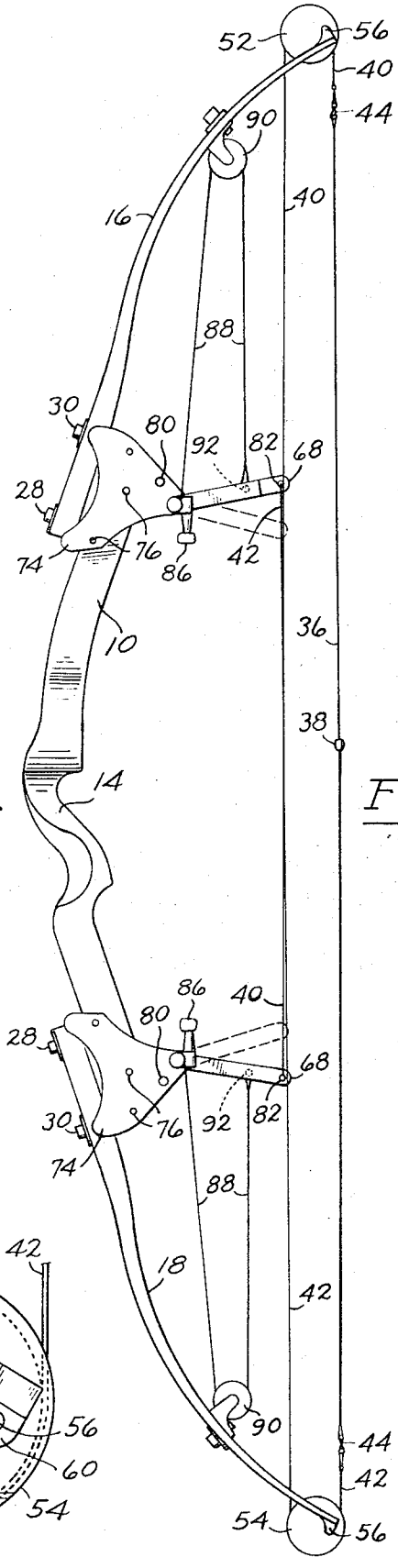


Fig. 1.

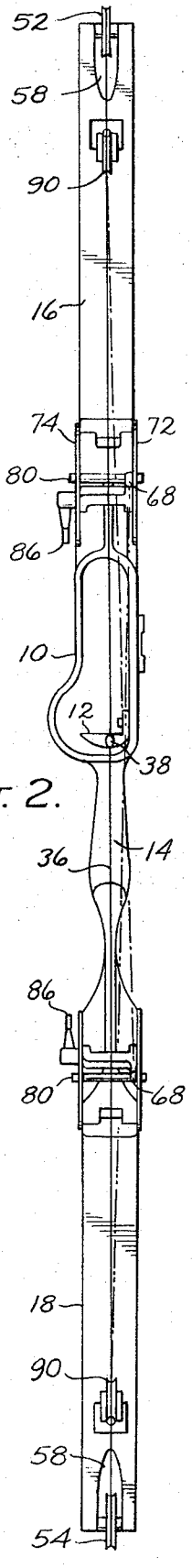


Fig. 2.

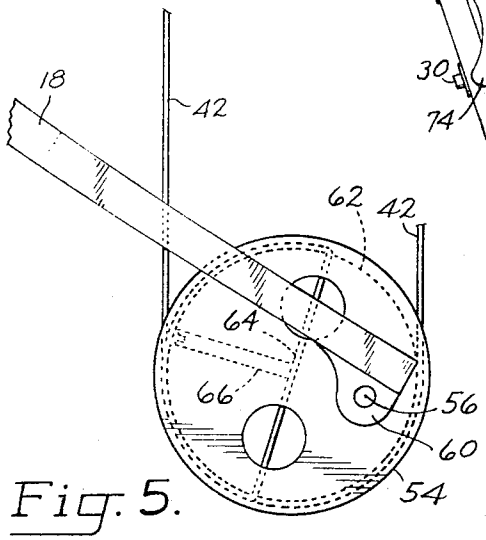


Fig. 5.

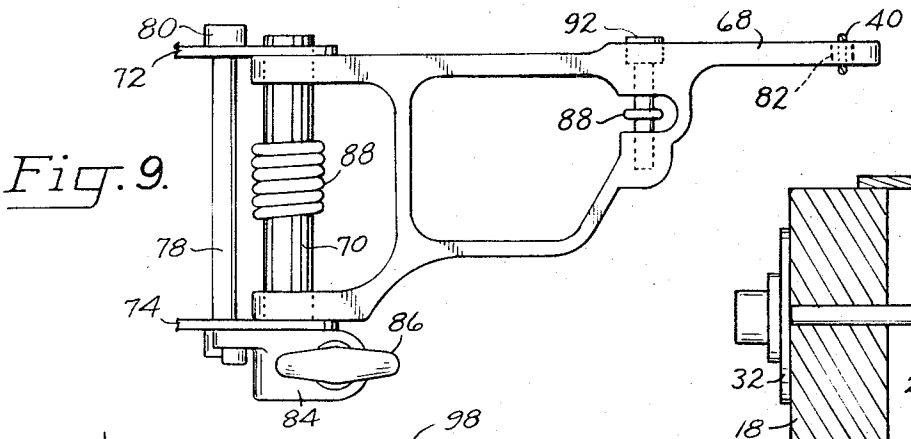


Fig. 9.

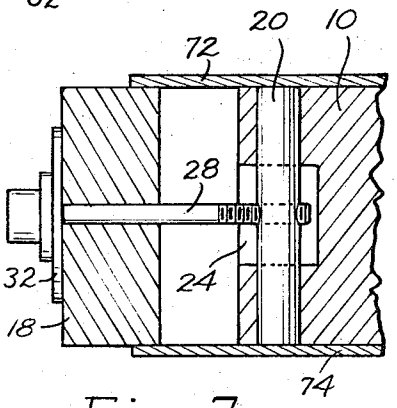


Fig. 7.

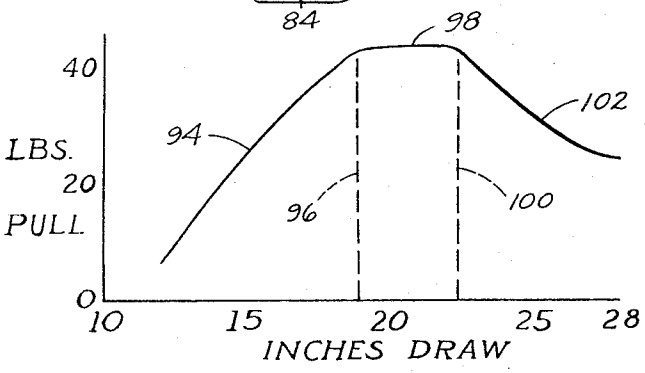


Fig. 10.

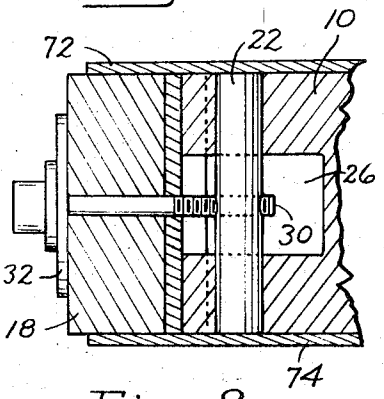


Fig. 8.

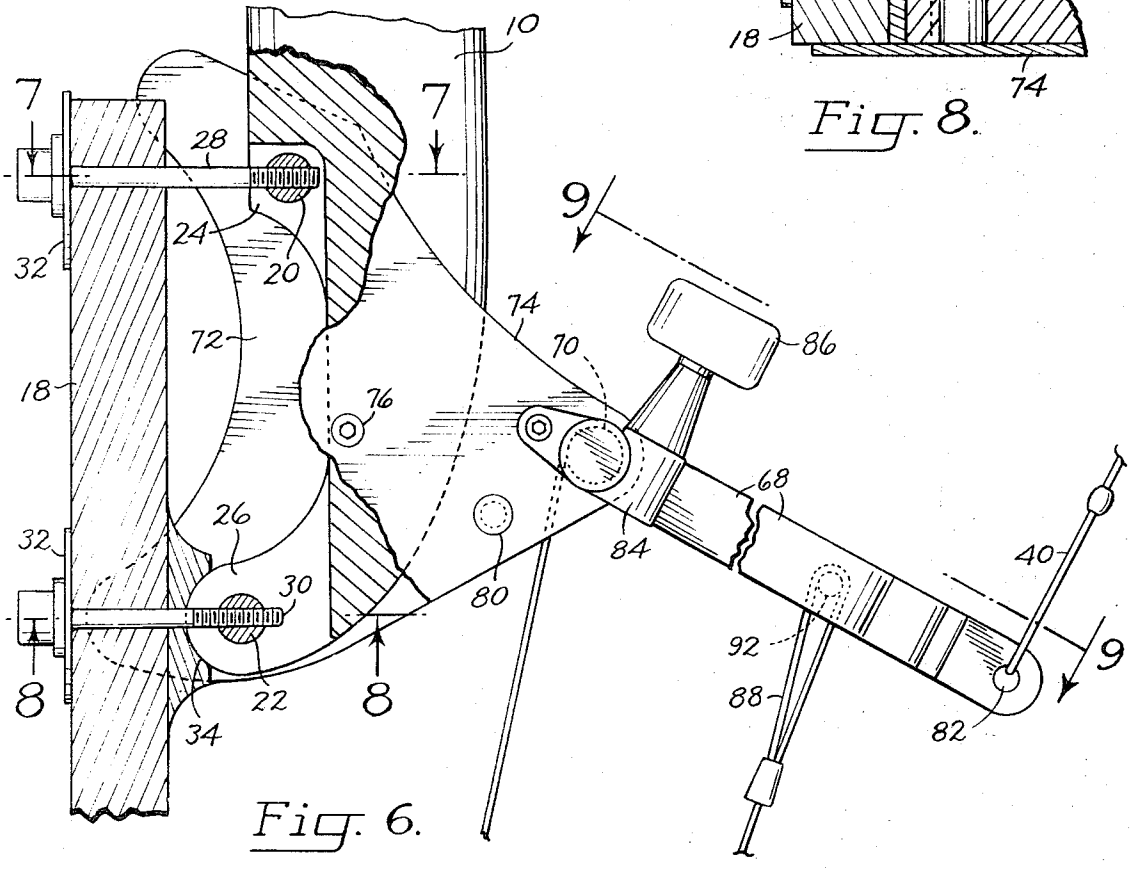


Fig. 6.

COMPOUND ARCHERY BOW

BACKGROUND OF THE INVENTION

This invention relates to archery bows, and more particularly to an archery bow characterized by requiring lesser pull weight at full draw than at an intermediate position of draw.

Archery bows of the class described, and commonly referred to as compound bows, have been provided heretofore. Their principal advantage resides in the reduction of pull weight at full draw, whereby an archer may utilize a pull weight greater than his normal capabilities, while simultaneously affording greater sighting control.

However, compound bows provided heretofore involve structures which provide only gross adjustment of limb angle and bow string pull weight. This imposes serious limitations upon the precision of balancing of the limbs and adjustability of the components of the bow. For example, it imposes the impracticable requirement of providing both limbs with identical characteristics of flexure and tensile strength, for otherwise the nocking point moves up and down during draw and release of an arrow, resulting in erratic arrow flight and inaccurate shooting. It also limits the degree of adjustability of the position of a nocking point relative to an arrow rest, and the angular disposition of the eccentrics and hence the characteristic pull weight relative to draw range.

Another limitation imposed upon the structure of prior compound bows resides in the interference with arrow movement by the close proximity of the crossing end segments of the bow string.

The foregoing and other limitations presented by prior compound bow constructions adversely affect the flight characteristics of an arrow and the degree of shooting accuracy attainable with such bows.

SUMMARY OF THE INVENTION

In its basic concept, the compound bow of this invention involves the adjustable connection of each cam at the opposite ends of the bow to an intermediate point on the opposite limb through a lever pivoted to the bow.

It is by virtue of the foregoing basic concept that the principal objective of this invention is achieved; namely, to overcome the aforementioned disadvantages and limitations of prior compound bows.

Another important object of this invention is the provision of a compound bow of the class described which affords a substantial degree of adjustability of the tensioning of a working stretch portion of a bow string the tensioning of the limbs and the characteristic pull weight relative to a portion of the draw range.

A further objective of this invention is the provision of a compound bow of the class described in which no interference is presented to the movement of the arrow.

The foregoing and other objects and advantages of this invention will appear from the following detailed description, taken in connection with the accompanying drawings of preferred embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a view in side elevation of a compound archery bow embodying the features of this invention.

FIG. **2** is a view in rear elevation as viewed from the right in FIG. **1.**

FIGS. **3** and **4** are fragmentary views in rear and side elevations, respectively, of a coupling for separate sections of a bow string.

FIG. **5** is a fragmentary view in side elevation, on an enlarged scale, of the eccentric member at the lower end of the bow in FIG. **1.**

FIG. **6** is a fragmentary view in side elevation and on an enlarged scale of the lower limb connector and tension control assembly of FIG. **1,** parts being broken away to disclose details of internal construction.

FIG. **7** is a fragmentary sectional view taken on the line **7—7** in FIG. **6.**

FIG. **8** is a fragmentary sectional view taken on the line **8—8** in FIG. **6.**

FIG. **9** is a fragmentary plan view as viewed in the direction of the arrows in **9—9** in FIG. **6.**

FIG. **10** is a graphical representation of pull weight relative to range of draw, characterizing the bow construction illustrated in FIG. **1.**

DESCRIPTION OF THE PREFERRED EMBODIMENTS

The bow includes a central handle member **10,** preferably made of light weight metal. As illustrated, it is provided with an arrow rest **12** mounted thereon above the hand grip **14.**

A pair of resilient limbs **16** and **18** extend outwardly one from each of the opposite ends of the handle member. Although the limbs may be formed integral with the handle, the detachable and adjustable arrangement illustrated is preferred. Thus, referring particularly to FIGS. **6, 7** and **8,** the inner end of the limb **18** is connected to the outer end of the handle by means of a pair of spaced pivot shafts **20** and **22** mounted in transverse bores in the handle. Intermediate portions of the handle registering with the bores are cut away, forming notches **24** and **26,** to accommodate the the inner ends of elongated screws **28** and **30** which extend removably through internally threaded diametric bores in the shafts. The screws also extend removably through openings provided in the limb. Washers **32** are interposed between the outer surface of the limb and the heads of the screws.

The terminal end portions of the handle, to opposite sides of the central notch **26,** are rounded arcuately to provide bearing surfaces which engage a correspondingly arcuate socket **34** provided on the rearward surface of the limb. Thus, by rotation of the adjusting screw **28** relative to its pivot shaft **20,** to move the screw longitudinally inward or outward relative to the shaft, the limb is caused to pivot about the bearing socket **34.** The angle of each limb relative to the handle thus may be adjusted independently of each other.

The bow includes a string by which an arrow is projected. In the embodiment illustrated, the string includes an elongated, intermediate working stretch **36** provided with the usual nocking point **38,** and a pair of opposite end segments **40** and **42** connected detachably to the opposite ends of the working stretch. The detachable connection of the adjacent ends of the working stretch and end segments preferably is provided by the coupling member illustrated in FIGS. **3** and **4.** The coupling member is of unitary construction and includes an elongated body **44** provided adjacent one end with an outwardly projecting eyelet **46,** or

other suitable form of connector. At the opposite end of the body a pair of lateral projections **48** extend in opposite directions relative to the longitudinal axis of the body.

The eyelet **46** is adapted for connection of the adjacent end of either the working stretch or the end segment. As illustrated, the eyelet connects the end segment as by means of a loop formed in the latter. The adjacent end of the working stretch is provided with a closed loop. It is slipped over the body **44** and retained in a notch **50** formed between the body and the eyelet. The inwardly extending portion of the loop then is crossed by 180° of rotation, and the spaced strands of the loop are lapped behind the lateral projections **48.**

The coupling member illustrated affords ready attachment and detachment of the bow string sections and imposes minimum stresses on the end loop of the section that extends between the notch **50** and the lateral projections **48.**

The opposite end segments **40** and **42** of the bow string are trained about a pair of cam members **52** and **54,** respectively, mounted at the outer ends of the limbs **16** and **18,** respectively, each by means of an eccentrically located pivot pin **56.** As best shown in FIG. **2,** each cam member is received freely within a central slot **58** provided at the outer end of each limb, and the pivot pin **56** is mounted at its opposite ends in apertured lugs **60** projecting outwardly from the laterally spaced finger portions of the limb which define the central slot.

In the preferred embodiment illustrated, and best shown in FIG. **5,** each cam member is in the form of a circular pulley provided with a single circumferential guide groove **62** and a diametric bore **64.** The end segment **42** leading from the working stretch **36** is trained about the guide groove clockwise for about 270° and is then extended through the diametric bore in the 7 o'clock direction illustrated in FIG. **5,** The portion of the end segment extending through the diametric bore is secured releasable therein by means of a set screw **66** mounted in a threaded bore which extends radially from the diametric bore substantially normal thereto. The end segment leading outward from the diametric bore then is wrapped clockwise along the guide groove for substantially 90°, from whence it is extended for connection to an adjustable tensioning control.

In the embodiment of FIG. **1,** and best illustrated in FIGS. **6** and **9,** the tensioning control includes a pair of elongated levers **68,** one associated with each of the end segments of the bow string. The inner end of each lever is mounted pivotally on a shaft **70** journaled in a pair of laterally spaced support plates **72** and **74** secured to opposite side surfaces of an end of the handle **10,** as by bolts **76.** Forwardly projecting portions of the plates extend closely along opposite side edges of the associated limb, and thus serve to confine the latter in longitudinal alignment with the handle. A spacer sleeve **78** extends laterally between the pair of plates adjacent the shaft and serves as a reinforcement for the plates. The spacer sleeve is retained in position by an elongated bolt **80** which extends through registering openings in the plates and the sleeve.

The outer end of each lever is provided with an opening **82,** or other suitable means, by which to connect the terminal end of the end segment of the bow string secured to the cam member at the opposite end of the bow. In the embodiment of FIG. **1,** the end segment **42** of the bow string extending upward from the bottom cam member **54** is connected to the outer end of the lever mounted at the upper end of the handle **10,** and the terminal end of the end segment **40** of the bow string extending downward from the top cam member **52** is connected to the outer end of the lever mounted at the lower end of the handle. Thus, it will be appreciated that the end segments of the bow string cross at the longitudinal center of the bow, slightly forward of the working stretch **36.** In order that the crossing end segments not interfere with the manipulation and movement of an arrow, the outer ends of the levers are offset laterally (FIG. **9**) from the plane of the working stretch. In this manner the crossing portions of the end segments also are offset laterally from the plane of the working stretch sufficiently to present no hindrance to the proper manipulation and movement of an arrow.

Means is provided for adjusting each of the levers **68** pivotally for adjusting the flexure, tension and timing of each limb, independently of the other. Thus, the pivot shaft **70** for each lever is provided in the form of a rotary reel. One end of the reel is connected through a conventional reduction gear assembly in a housing **84** to a control knob **86** adapted to be rotated by hand. The reduction gear housing is secured to one of the side plates by such means as a screw.

One end of an elongated, flexible control cable **88** is secured to each rotary reel **70.** The cable extends outwardly therefrom and is trained about a pulley **90** mounted on the rear surface of the associated limb, inwardly of the cam member. The cable then extends inward from the pulley and is secured at its terminal end to the associated lever **68** by means of a pin **92** mounted on the lever intermediate the ends of the latter. The control cable thus operatively interconnects the lever and the associated limb, such that rotation of the reel to take in or pay out the cable functions to increase or decrease the tension and curvature of the limb.

As the control cable **88** is taken up on, or paid out from the reel **70,** the connected lever **68** is caused to rotate about the axis of the reel toward, or away from the associated pulley **90.** Since the end segments **40** and **42** of the bow string connect the cam members **52** and **54,** respectively, to the levers at the opposite ends of the handle **10,** such movement of each lever also functions to vary the rotational position of the opposite cam member. Accordingly, rotational adjustment of each reel also serves to adjust the tension of the bow string and the longitudinal position of the nocking point **38.**

The connection of the cams **52** and **54** to the opposite limbs **18** and **16,** respectively, through the bow string end segments **40** and **42,** levers **68,** control cables **88** and pulleys **90,** provides still another important function; namely, the maintenance of limb balance throughout the draw and release of an arrow. To illustrate, let it be assumed that the upper limb **16** (FIG. **1**) is weaker than the lower limb **18.** Thus, during the draw the upper limb tends to bend more than the lower limb, with consequent greater clockwise rotation of cam **52** than counterclockwise rotation of cam **54.**

The greater rotation of cam **52** produces an upward pivotal movement of the lower lever **68** greater than the downward pivotal movement of the upper lever **68.** Accordingly, the greater upward movement of lower

lever **68** functions, through the connected control cable **88,** to cause greater bending of the lower limb **18,** to match the bending of the weaker, upper limb **16.** Both limbs thus remain in balance during draw and release of an arrow. This is reflected in movement of the nocking point **38,** and hence the arrow, along a straight line extending through the arrow rest **12.**

In the operation of the archery bow illustrated in FIG. **1,** as the working stretch **36** is drawn rearward from the rest position illustrated to the position of full draw, the eccentric cam member **52** at the top of the bow is caused to rotate clockwise about the axis of its pivot shaft **56** and the eccentric cam member **54** at the bottom of the bow is caused to rotate counterclockwise about the axis of its pivot shaft. These pivotal movements of the eccentric cam members operate to produce a varying pull weight which is characterized by the curve illustrated in the graph of FIG. **10.**

Thus, as the draw proceeds from the rest position, the pull weight increases substantially uniformly along the line segment **94** to an intermediate position of draw indicated by the broken line **96.** The pull weight then remains substantially constant through a further intermediate length of draw, as indicated by the line segment **98** extending to the broken line **100.** The pull weight thereafter decreases progressively to the position of full draw, along the line segment **102.**

In the illustration of FIG. **10,** the intermediate extent of maximum pull weight of about 43 pounds occurs through the draw range of about 18 inches to about 23 inches, and the pull weight at maximum draw of 28 inches is about 24 pounds. Accordingly, since the archer is required to sustain only 24 pounds of pull weight at full draw rather than the maximum of 43 pounds, he is better able to establish and maintain sighting control preliminary to shooting.

The characteristic pull weight curve illustrated in FIG. **10** is retained substantially constant throughout the range of adjustment of limb and bow string tension. It will be understood, however, that the position of the curve varies in the vertical direction of the ordinate as the bow string tension is varied.

If desired, the position of the curve may be shifted horizontally by varying the diameter of the eccentric cam members **52** and **54.** Further, the extent of maximum pull weight, i.e., the length of the line segment **98,** may be varied by varying the spacing between the opening **82** and pin **92** on each lever **68.** The length of the line segment **98** increases as the spacing between opening **82** and pin **92** is increased and decreases as said spacing is decreased. Similarly, but not preferably, the length of line segment **98** may be increased or decreased by decreasing or increasing, respectively, the diameter of pulleys **90.**

However, the spacing between opening **82** and pin **92** and the diameter of pulleys **90,** as well as the spacing of pulleys **90** from the cam pivots **56,** are chosen to obtain optimum shooting characteristics of the bow. Thus, the spacing between opening **82** and pin **92** is chosen to provide a sufficient length of line segment **98** to achieve optimum stability of nocking point movement and arrow flight, without adversely shifting the broken line **96** (FIG. **10**) rearward; the diameter of pulleys **90** is correlated with the spacing between opening **82** and pin **92** to preserve the desired length of line segment **98;** and the spacing of pulleys **90** from cam pivots **56** is chosen to avoid mushy or too rapid flexing of the limbs.

From the foregoing it will be appreciated that the present invention provides a compound archery bow construction which maintains balance of both limbs even though they may have somewhat different characteristics of tension and flexure, and which affords independent adjustment of the flexure and tension of each of the pair of limbs. This construction materially reduces the manufacturing cost of the limbs, as previously discussed, and yet affords a much greater degree of precision of adjustment of the bow components, and hence produces greater shooing accuracy than has been attainable heretofore.

It will be apparent to those skilled in the art that various changes may be made in the size, shape, type, number and arrangement of parts described hereinbefore, without departing from the spirit of this invention.

Having now described my invention and the manner in which it may be used, I claim:

1. A compound archery bow, comprising:

a. a handle member,

b. a pair of bow limbs projecting from opposite ends of the handle member,

c. a pair of cam members, each said cam member being mounted on one of said bow limbs and each said cam member being pivoted eccentrically adjacent the outer end of each its associated limb,

d. a bow string for projecting an arrow, said bow string spanning between said cam members and being secured intermediate its ends to the pair of cam members and forming an intermediate working stretch therebetween, a pair of opposite end segments of said bow string extending from the cam members,

e. a pair of elongated levers mounted pivotally on the bow, each said lever being positioned adjacent the inner end of its associated limb, the outer end of each lever being connected to the end segment of the bow string which is secured to the cam member on the opposite limb, and

f. a pair of tension control cables, each said tension control cable operatively interconnecting each said limb and its associated lever and each said tension control cable being positioned between the bow limb and the connection of the bow string end segment to its associated lever.

2. The archery bow of claim **1** wherein each cam member has a peripheral guide groove for confining the bow string therein, a bore through the cam member receives a portion of the bow string therethrough, and a set screw which removably intercepts said bore for securing the bow string therein.

3. The archery bow of claim **1** including adjusting means associated with each control cable for adjusting the length thereof and to effect adjustment of the tension of its associated limb.

4. The archery bow of claim **1** including

a. a pulley mounted on each limb intermediate the associated cam member and associated lever,

b. a rotary reel for each control cable and mounted on the bow inwardly of the associated pulley,

c. each control cable being secured at one of its ends to its associated lever, then passed around its associated pulley and secured at its opposite end to its associated reel.

5. The archery bow of claim 4 wherein the connection of each bow string end segment to its associated lever is offset laterally from the working stretch of the bow string.

6. The archery bow of claim 1 wherein the connections of the bow string end segments and control cables to each lever are spaced apart a distance predetermined to produce a maximum pull weight which remains substantially constant throughout a predetermined intermediate portion of the draw length.

7. The archery bow of claim 1 wherein the bow string includes a separate working stretch and a pair of separate end segments and one of the adjacent ends of the working stretch and end segments is provided with a flexible loop, said adjacent ends of the working stretch and end segments are connected together detachably by a pair of coupling members each comprising:

a. an elongated, one-piece body,

b. an outwardly projecting connector member adjacent one end of the body for releasable connection of one of said working stretch and end segment, and

c. a pair of lateral projections on the end of the body opposite the connector member,

d. whereby the flexible loop is engaged behind the projecting connector and the loop's spaced strands are lapped behind the lateral projections.

8. In an archery bow having a handle member and a pair of separate limbs extending from the opposite ends of the handle member, means connecting the inner end portion of each limb to the associated end of the handle member for angular adjustment of the limb relative to the handle member, each said means comprising;

a. interengaging bearing means on the outer end of the handle member for engaging the inner end portion of it's associated limb,

b. a first pivot shaft mounted on the handle member and extending, said shaft being closely adjacent to the interengaging bearing means,

c. a first adjustment screw engaging the first pivot shaft and extending perpendicularly therefrom through the interengaging bearing means and its associated limb,

d. a second pivot shaft mounted on the handle member inwardly of the first pivot shaft and extending parallel thereto, and

e. a second adjustment screw engaging the second pivot shaft and extending perpendicularly therefrom through its associated limb adjacent the inner end thereof,

f. said second adjustment screw being adjustable longitudinally relative to the second pivot shaft, whereby to pivot the limb on said interengaging bearing means and vary the angular relationship between the limb and handle member.

* * * * *

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,841,295 Dated October 15, 1974

Inventor(s) LAFAYETTE D. HUNTER

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

In the tenth line of the Abstract the word "balance" should read --produce--.

Column 1, line 53, insert a comma after "string".

Column 8, line 10, after "extending" insert --therethrough--.

Signed and sealed this 31st day of December 1974.

(SEAL)
Attest:

McCOY M. GIBSON JR.
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents

FORM PO-1050 (10-69)

USCOMM-DC 60376-P69
* U.S. GOVERNMENT PRINTING OFFICE : 1969 O—366-334.