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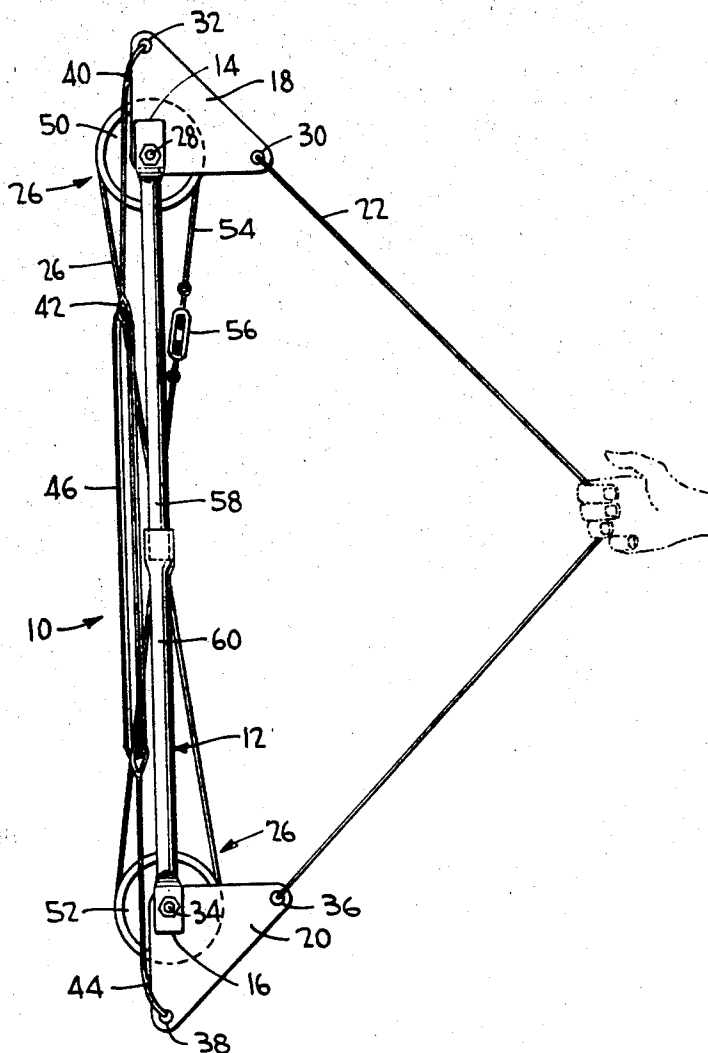
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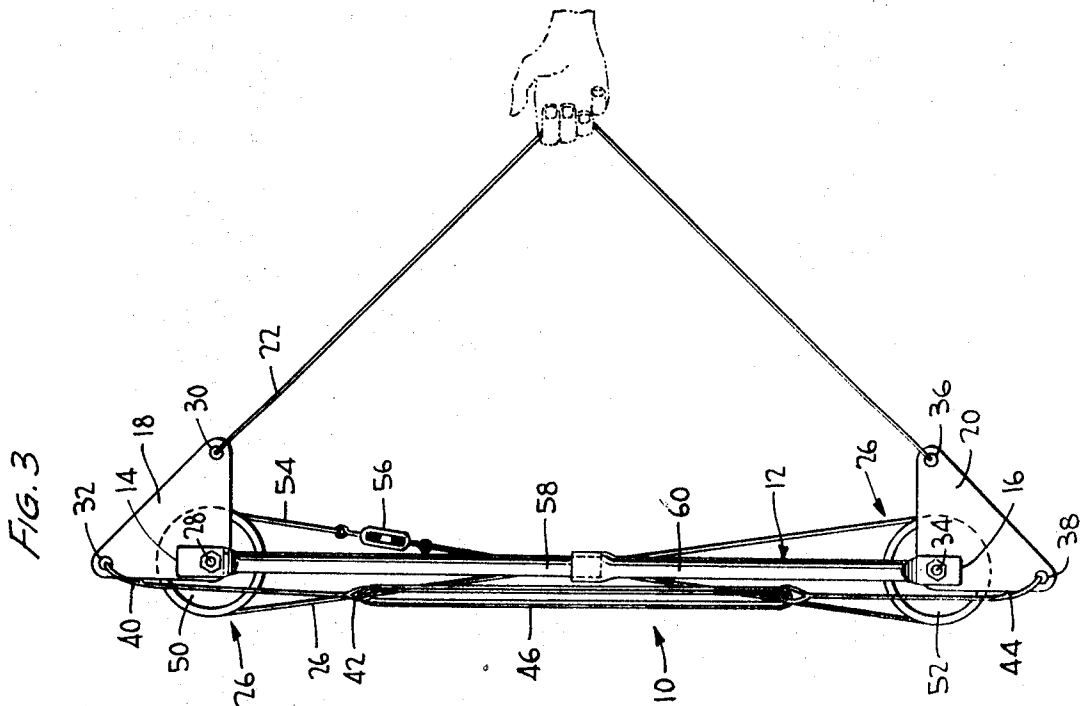
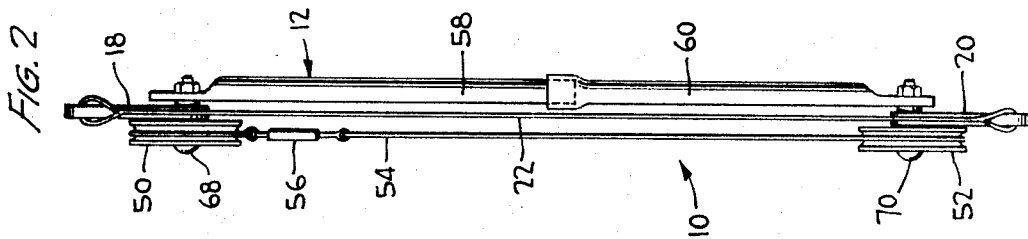
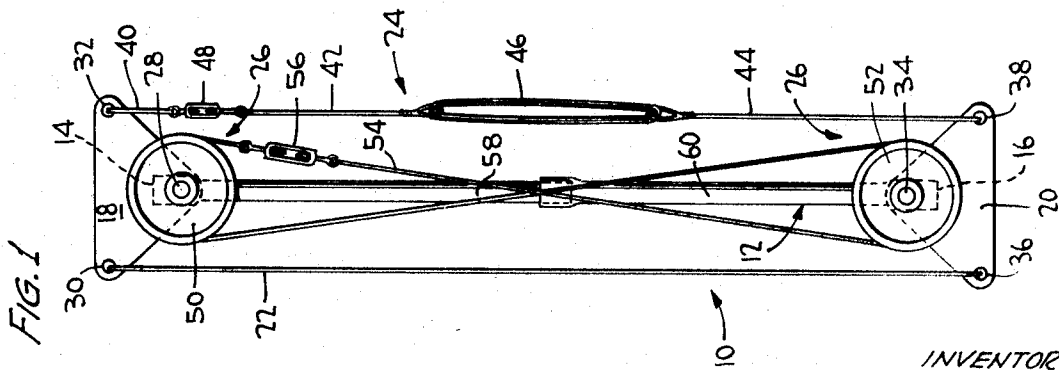
[54] **ARCHERY BOW WITH FORCE-MULTIPLYING LINKAGE**
8 Claims, 6 Drawing Figs.

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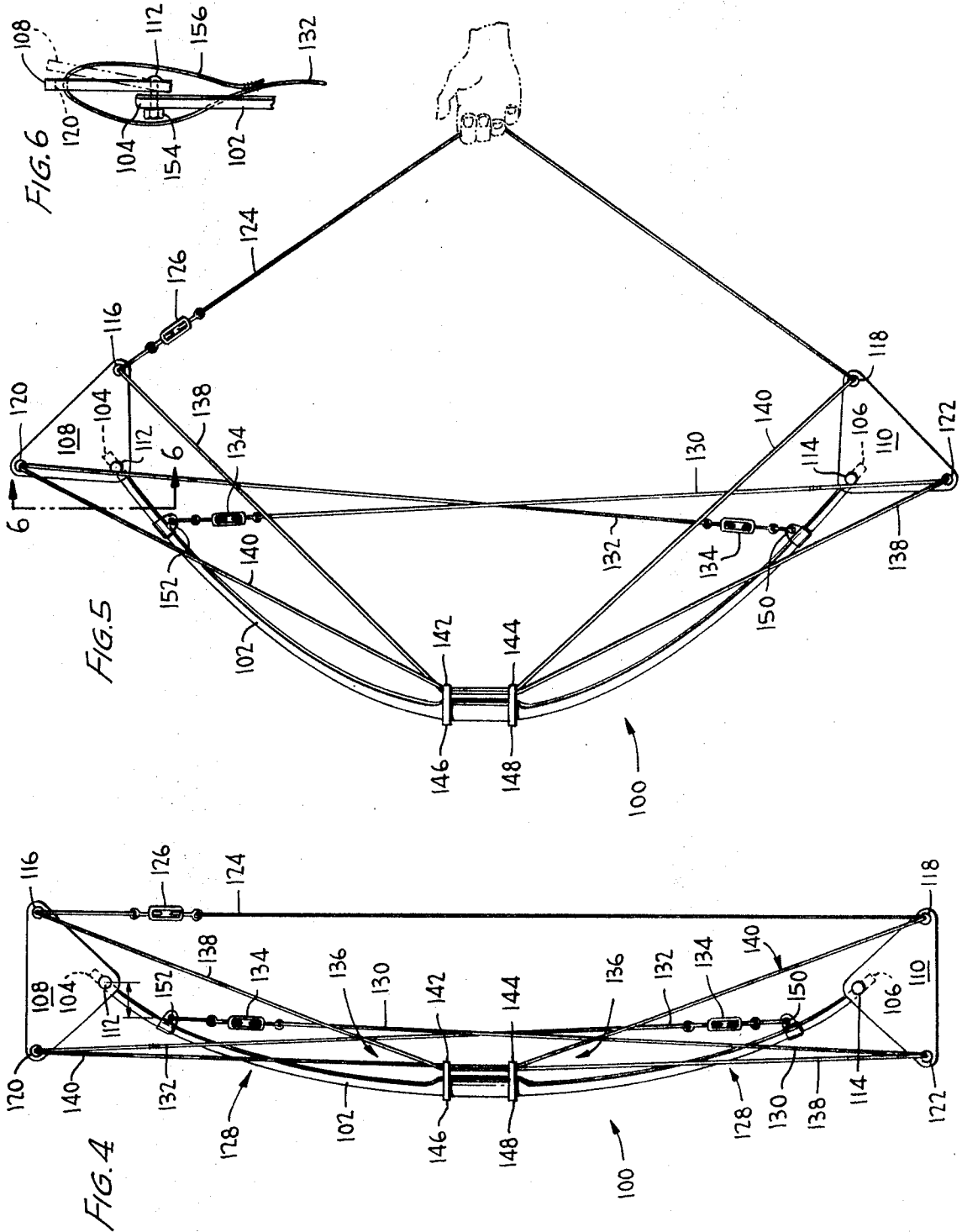
ABSTRACT: An archer's bow utilizing a pair of end mounted rotatable rocker arm members to develop a mechanical advantage permitting the use of less force to hold the bow in a fully drawn position than would be required without such members. The bow comprises a bow member, end mounted rotatable rocker arm members, a draw cable member or bowstring connecting the rocker arms, an elastic device resisting rotation of the rocker arms, and link means to ensure substantially equal but opposite angular displacement of the rocker arms.





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ARCHERY BOW WITH FORCE-MULTIPLYING LINKAGE

This invention pertains to an archer's bow. In particular this invention pertains to an archer's bow utilizing end mounted rotatable mechanical means to develop a mechanical advantage permitting the use of considerably less force for drawing the bow toward and holding it in a fully drawn or loaded position than would be required without such means.

A problem of archers throughout the ages has been to develop a powerful bow which could be easily handled without fatigue, which could be held steady for taking aim, and which could propel an arrow a great distance with great accuracy. One solution has been the well-known crossbow which can be drawn or loaded mechanically, locked into a drawn position by means of a solid brace between bow and string, held steady for taking aim, and fired by means of a simple trigger. Loading a crossbow is often an awkward task, and the bow itself is often heavy and cumbersome.

A further problem faced by archers has been the provision of an arrow of sufficient strength not to snap or splinter at the instant that the full thrust of the bowstring was loosed against it. The solution in the past has generally been to provide a sturdier and therefore heavier arrow. This required a sacrifice of some of the distance across which the fixed strength bow was capable of driving the arrow. A lighter arrow will generally travel faster and farther than a heavier arrow shot from the same bow.

The aforementioned and other problems have been solved by applicant who has invented a novel archer's bow provided with a pair of rotatable rocker arm members secured to opposite ends of the bow and to the bowstring to generate a mechanical advantage permitting the use of less force for drawing the bow toward and holding it in a drawn or loaded position than would be required without such members. The arrangement is such that the mechanical advantage increases continuously from a minimum to a maximum as the bow is drawn. As the bowstring is released, the thrust on the arrow builds from a minimum to a maximum, thus permitting the use of lighter weight arrows than with conventional bows.

The rocker arm members each have first, second and third locations spaced predetermined distances from each other. These members are rotatably mounted to opposite ends of the bow at their respective first locations. The bowstring or draw cable connects the members at their respective second locations, while an elastic device applies a force to the respective third locations tending to resist rotation or angular displacement of the pair of rocker arms. A link means assures that the angular displacements of the rocker arms with respect to one another are substantially equal in magnitude but opposite in direction. This in turn assures that only an even forward thrusting motion is given to the bowstring and to any arrow it carries, when the bowstring is released.

For a more detailed description, reference is now had to the drawings in which:

FIG. 1 is a top plan view of one of the embodiments of the archer's bow of this invention;

FIG. 2 is a side view of the bow of FIG. 1;

FIG. 3 is a bottom plan view of the bow of FIG. 1 shown in a drawn condition;

FIG. 4 is a top plan view of a second embodiment of the archer's bow of this invention;

FIG. 5 is a top plan view similar to that of FIG. 4 showing a bow of the second embodiment in a drawn position; and

FIG. 6 is an incomplete exaggerated front view of parts of the bow and rocker arm structure located at the top of the embodiment of this invention shown in FIGS. 4 and 5, and illustrates a suggested improvement.

A first embodiment 10 of the archer's bow of this invention is shown in FIG. 1 to comprise an elongated bow member 12 having opposite ends 14 and 16, a pair of rocker arm members 18, and 20, a flexible draw cable member or bowstring 22, an elastic device 24, and link means 26.

Rocker arms 18 and 20 are each provided with first, second and third locations 28, 30, 32 and 34, 36, 38, respectively, said locations being spaced predetermined distances from each other. The rocker arms 18 and 20 are each rotatably mounted at their respective first locations 28 and 34 to opposite ends 14 and 16 of elongated bow member 12. Flexible draw cable member 22 connects at its opposite ends the rocker arm members at their respective second locations 30 and 36.

The positions of rocker arms 18 and 20 in FIG. 1 have been chosen to simplify the illustration by reducing to a minimum the number of cables overlying one another. It is preferable that an actual embodiment of the bow of FIG. 1 be designed so that in its unloaded rest condition the rocker arms are positioned so that second location 30, first location 28, first location 34 and second location 36 all lie substantially along the same straight line in the order just stated.

The elastic device 24 is connected to the rocker arm members at their respective third locations 32 and 38. Device 24 applies to said third locations a force which under normal conditions resists the rotation or angular displacement of the rocker arms 18 and 20 and urges them to return to their original rest or equilibrium position. Device 24 is shown to comprise cable portions 40, 42 and 44, an elastic band 46, and a turn buckle 48 for adjusting the cable lengths. The elastic band 46 could be replaced by a metallic coil spring or by other elastic apparatus; indeed, the entire elastic device 24 could be replaced by a single elastic band, by a single coil spring, or by other similar elastic apparatus.

Link means 26 are provided to assure that any angular displacements of the rocker arms with respect to one another are substantially equal in magnitude but opposite in direction.

The link means 26 comprise pulley means 50 and 52, and a cable means 54 having an adjustable turnbuckle 56. The pulley means 50 and 52 are securely attached to rocker arms 18 and 20, respectively, at their respective first locations 28 and 34. Cable means 54 is strung as shown in a tight figure "8" pattern about pulleys 50 and 52. With such a construction rotation or angular displacement of either pulley or either rocker arm will cause movement of cable means 54 which in turn will cause a corresponding equal magnitude but oppositely directed movement of the opposite pulley and rocker arm.

In the embodiment of this invention shown in FIGS. 1 to 3 the elongated bow member 12 is preferably constructed of a nonflexible material and can comprise a plurality of detachable sections 58 and 60 designed, for example, for telescopic engagement.

FIG. 2 illustrates a side view of the archer's bow of FIG. 1. Bolts 68 and 70 are shown as one means for rotatably mounting rocker arms 18 and 20 together with their respective pulleys 50 and 52 to the elongated bow member 12.

FIG. 3 is a bottom plan view of the archer's bow of FIG. 1 showing the bow in a drawn position. Pulling with one hand upon draw cable means 22 has caused rotation or angular displacement of rocker arm members 18 and 20. Link means 26 comprising pulleys 50 and 52, as well as cable means 54 have assured that the angular displacements of the rocker arms with respect to one another have been substantially equal in magnitude but opposite in direction. Such displacements have caused the respective third locations 32 and 38 of rocker arm members 18 and 20 to move away from each other drawing with them cable means 40 and 44, thereby causing elastic deformation of the elastic band 46 which in turn exerts a force upon the rocker arm members at their respective third locations resisting their rotation. That force is exerted along cable means 40 and 44.

In the position shown in FIG. 3 the respective first (28 and 34) and third (32 and 38) locations of rocker arm members 18 and 20, as well as the line (i.e. cable means 40 and 44) along which the aforementioned force is applied all lie substantially along a single straight line. Second locations 30 and 36 however are located at substantially equal distances away from that line. As the torque generated by the aforementioned force acting upon the rocker arms in a manner which would

cause them to return to their original position is almost zero at the position shown in FIG. 3, only a very slight force is required to be exerted upon draw cable means 22 to maintain the bow drawn. This is so even though a great contracting force is being exerted by elastic device 24.

FIGS. 4 and 5 illustrate a second embodiment 100 of the archer's bow of this invention which utilizes an elastically deformable flexible member 102, resembling the more commonly known varieties of archers' bows, as the elongated bow member. This elastically deformable flexible member 102 has opposite ends 104 and 106 upon which rocker arm members 108 and 110 are rotatably mounted. Rocker arm members 108 and 110 are provided with first (112 and 114), second (116 and 118), and third (120 and 122) locations respectively. These locations are spaced predetermined distances from each other. The rocker arms are rotatably mounted or fulcrumed to the bow member 102 at their respective first locations 112 and 114. A draw cable means or bowstring 124 provided with a turn buckle 126 connects rocker arms 108 and 110 at their respective second locations 116 and 118.

The positions of rocker arms 108 and 110 in FIG. 4 have been chosen to simplify the illustration by reducing to a minimum the number of cables overlying one another. It is preferable that an actual embodiment of the bow of FIG. 4 be designed so that in its unloaded rest condition the rocker arms are positioned so that second location 116, first location 112, first location 114 and second location 118 all lie substantially along the same straight line in the order just stated.

An elastic device 128 is connected to rocker arms 108 and 110 at their respective third locations 120 and 122 applying to those third locations a force normally resisting any rotation or angular displacement of the rocker arm members. In this embodiment the elastic device 128 comprises first connecting means 130 and 132 linking the third locations 120 and 122, respectively, of rocker arm members 108 and 110 to points 150 and 152 respectively on bow member 102. Points 150 and 152 are located on bow member 102 several inches from ends 106 and 104, respectively. In other words, first connecting means 130 links the third location 122 of rocker arm 110 with point 152 on bow member 102, while first connecting means 132 links third location 120 of rocker arm 108 with point 150 on bow member 102. These first connecting means may be cables equipped with turn buckles 134.

Link means 136 have been provided to assure that any angular displacements of the rocker arms with respect to one another are substantially equal in magnitude and opposite in direction. These link means 136 comprise second connecting means 138 and 140 which link the respective third locations 120 and 122 of rocker arm members 108 and 110 to the respective second locations 116 and 118 of the other rocker arm member. In other words, second connecting means 138 links second location 116 of rocker arm 108 with the third location 122 of rocker arm 110, while second connecting means 140 links second location 118 of rocker arm 110 with the third location 120 of rocker arm 108. Guide means 142 and 144 comprising eyelets, hook eyes or the like may be provided to slidably secure the second connecting means to bow member 102 at points 146 and 148 approximately midway between the opposite ends 104 and 106 of bow member 102. Second connecting means 138 and 140 would then pass through the eyes of such eyelets or hook eyes.

FIG. 5 shows the embodiment of FIG. 4 in a drawn and tensioned position. Draw cable means or bowstring 124 has been drawn back causing rotation or angular displacement of rocker arms 108 and 110. Linking means 136 comprising second connecting means 138 and 140, and eyelets 142 and 144, have insured that the rotations of rocker arms 108 and 110 have been substantially equal in magnitude and opposite in direction. Rotation of the rocker arms has caused their respective third locations 120 and 122 to separate from one another, and to draw upon first connecting means 130 and 132, respectively. This in turn has caused the arching or bending of bow member 102. A force tending to oppose the rota-

tion or angular displacement of rocker arms 108 and 110 has been applied to their respective third locations 120 and 122 along respective first connecting means 132 and 130. In the position shown in FIG. 5 the respective first (112 and 114) and third (120 and 122) locations of rocker arms 108 and 110, as well as the line (i.e., cable means 130 and 132) along which the aforementioned force is applied all lie substantially along a single straight line. In this position the torque which is generated by the tension exerted upon first connecting means 130 and 132, and which tends to cause rocker arms 108 and 110 to return their original positions is essentially zero. Thus, the bow may be held in this position by exerting an extremely small amount of force upon draw cable means or bowstring 124 in spite of the fact that considerable tension is being exerted by bow member 102 along connecting means 130 and 132.

To illustrate the advantages of the bow of FIGS. 4 and 5 over a conventional bow of equal draw weight, the following experimental data is provided. A conventional 30-pound bow was compared with a 30-pound bow of the type illustrated in FIGS. 4 and 5. Each bow was drawn a predetermined distance from its rest position and the force required to hold the bowstring at the new position measured.

The above data shows that applicant's bow could be held at full draw by exerting an 8-pound force, while a 30-pound force was required to hold the conventional bow. Further, it can be seen that when loosed the bowstring of the conventional bow would instantly exert a 30-pound thrust on an arrow, while applicant's bow would exert an 8-pound thrust which would soon build to 30 pounds. A lighter and less sturdy arrow could then be shot, without splintering, from applicant's bow than from the conventional bow.

FIG. 6 is an incomplete exaggerated front view of parts of the bow and rocker arm structure at end 104 of the bow of FIGS. 4 and 5, showing a modification which can improve this type of bow. When the rocker arm 108 is rotatably mounted at one side of bow 102, as is shown in FIGS. 4-6, the tension on cable 132 acting on rocker arm 108 at third location 120, can develop a torque on the bolt 154 connecting the rocker arm to bow end 104. This in turn can cause the rocker arm and bow end 104 to twist out of the plane containing bow 102 and drawstring 124. In FIG. 6 the position which the rocker arm might take as a result of such twisting is shown by dotted lines. Such twisting can be substantially eliminated by providing a large loop 156 at the end of cable 132, the loop 156 having the end portion of bow 102 passing through it. Such an arrangement distributes the tension of cable 132 to both faces of rocker arm 108 and tends to keep the rocker arm properly upright.

Many variations in the two embodiments of the archer's bow of this invention which have been described are possible. All of the cable means, draw string means, and connecting means can be constructed of metal cable, wire, rope, string, twine, and other similar materials. Turnbuckles can be provided if desired along the various cables of these devices to permit adjustment. The rocker arm members may be constructed in any desired shape, such as for example, triangular or in the form of angle irons. The rocker arm members may be rotatably mounted to the bow member in any convenient manner such as by means of an appropriate bolt or by use of an appropriate hinge. The flexible bow member may be constructed of wood, metal, plastic or any other convenient material. The same is true for the nonflexible bow member. The first, second and third locations on the rocker arms may comprise holes piercing the rocker arms or merely projections adapted for securing cables and the like. Many other modifications of this invention will be obvious to those skilled in the art.

What I claim is:

1. An archer's bow comprising:
an elongated bow member having opposite ends;
a rocker arm member pivotally secured to said bow member at each said end, each said member having a first, second

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and third location spaced predetermined distances from one another, each said member being secured to said ends at its first locations and being so oriented that said respective second and third locations each lie on an opposite side of said bow member ends;

a flexible draw cable member secured at its opposite ends to said rocker arm members at their respective second locations;

an elastic device interconnecting said members at their respective third locations; and

link means interconnecting said rocker arm members;

said draw cable member and said elastic device together being of equal lengths and serving to maintain said rocker arm members in a position of rest relative to said bow member whereby lines joining, respectively, said second and third locations are parallel to one another;

said rocker arm members being angularly displaced from their said position of rest to a fully bow drawn positions during which alteration of said elastic device serves to apply a force to said rocker arm members in response to the alteration of said elastic device,

said link means serving to assure that the alteration of said rocker arm members with respect to one another are equal in magnitude and opposite in direction and said respective first and third locations of each rocker arm member and a line along which said force is applied, with the bow drawn being substantially along a straight line.

2. A bow as defined in claim 1 wherein said elongated bow

member comprises an elastically deformable flexible member.

3. A bow as defined in claim 2 wherein said elastic device comprises first connecting means linking at its opposite ends said third location of one of said rocker arm members with said bow member near said end thereof opposite said one rocker arm member and further linking at its opposite ends the other of said rocker arm members at its third location with said bow member near said end thereof opposite said other rocker arm member.

4. A bow as defined in claim 3 wherein said link means comprises second connecting means linking said second location of said one rocker arm member together with said third location of said other rocker arm member and further linking said third location of said one rocker arm member together with said second location of said other rocker arm member.

5. A bow as defined in claim 4 wherein guide means are provided to slidably secure said second connecting means to said bow member at points approximately midway between said opposite ends of said bow member.

6. A bow as defined in claim 1 wherein said elongated bow member is rigid.

7. A bow as defined in claim 6 wherein said link means comprises a pulley rotatively secured to each said rocker arm members at their respective first locations, and further comprises a cable cooperating with said pulleys.

8. A bow as defined in claim 7 wherein said elongated bow member comprises a plurality of detachable sections.

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