United States Patent

[11] 3,623,065

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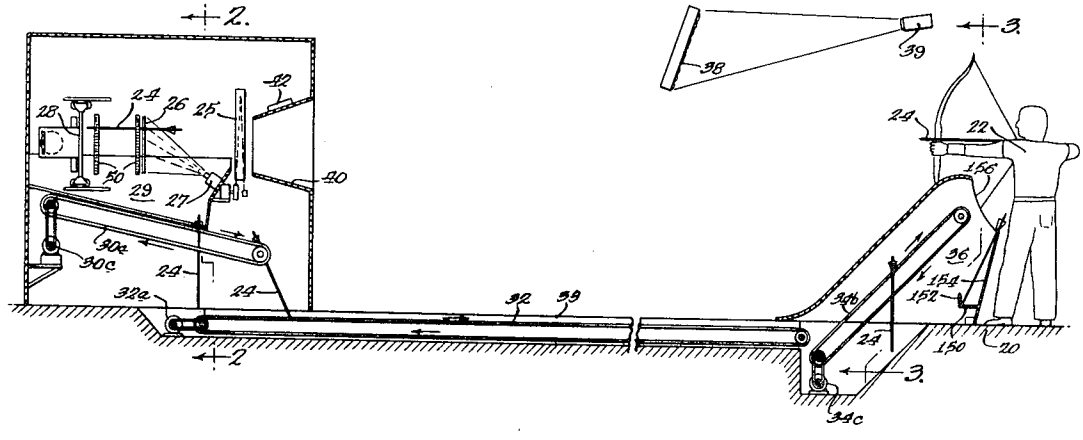
[54] **ARROW HIT LOCATION INDICATOR**
9 Claims, 9 Drawing Figs.

[52] **U.S. Cl.** ..... **340/323,** 273/102.2 R
[51] **Int. Cl.** **A63b 71/06**
[50] **Field of Search** ..... 340/323; 273/102.2 R

[56] **References Cited**
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3,401,937 9/1968 Rockwood et al. 273/102.2

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ABSTRACT: An automatic archery range including a firing line or shooting station from which arrows are fired in a flight path towards a penetrable target, a self ejecting arrow receiving and holding backstop behind the target, an arrow collector beneath the backstop, arrow return means for receiving arrows from the collector and returning them to a quiver adjacent the firing line or shooting station, a target monitor observable by an archer from the shooting station or firing line for indicating to the archer or to spectators where the arrows have hit the target and means for scanning the flight path for sensing the position on the target hit by fired arrows and operating the target monitor.



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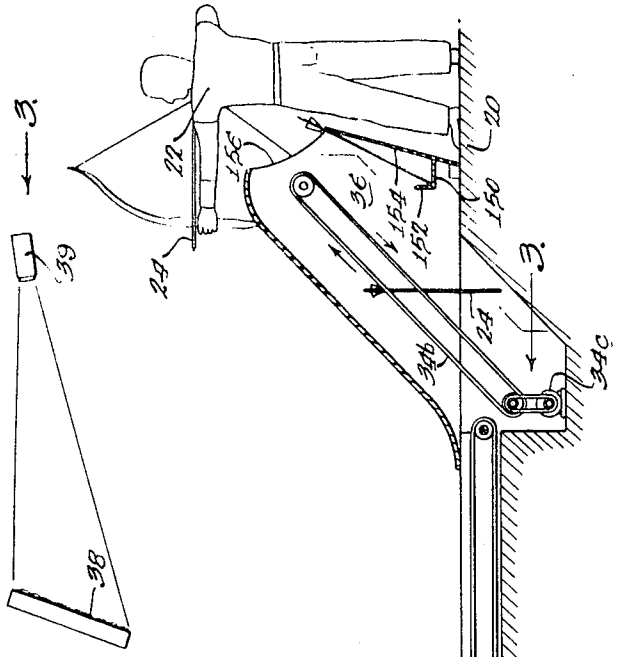


Fig. 1.

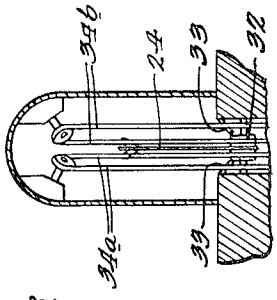
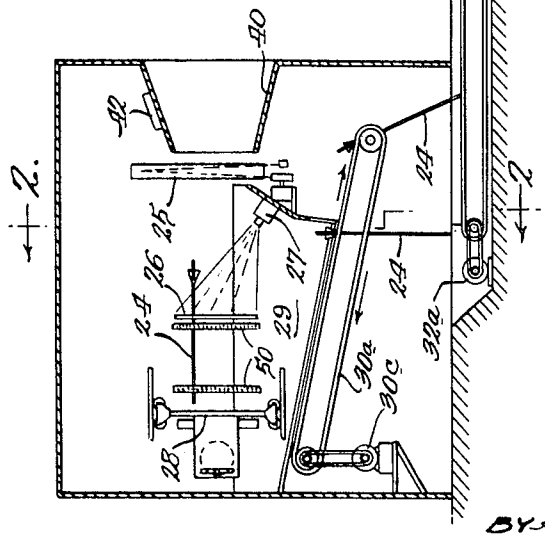


Fig. 3.



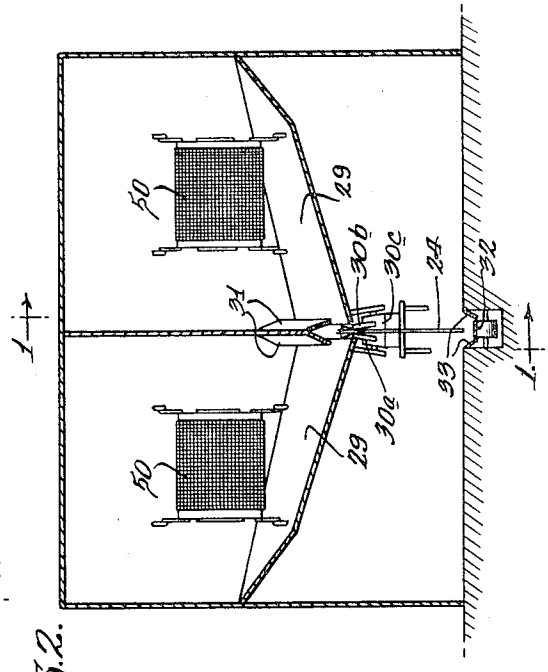


Fig. 2.

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Fig. 4.

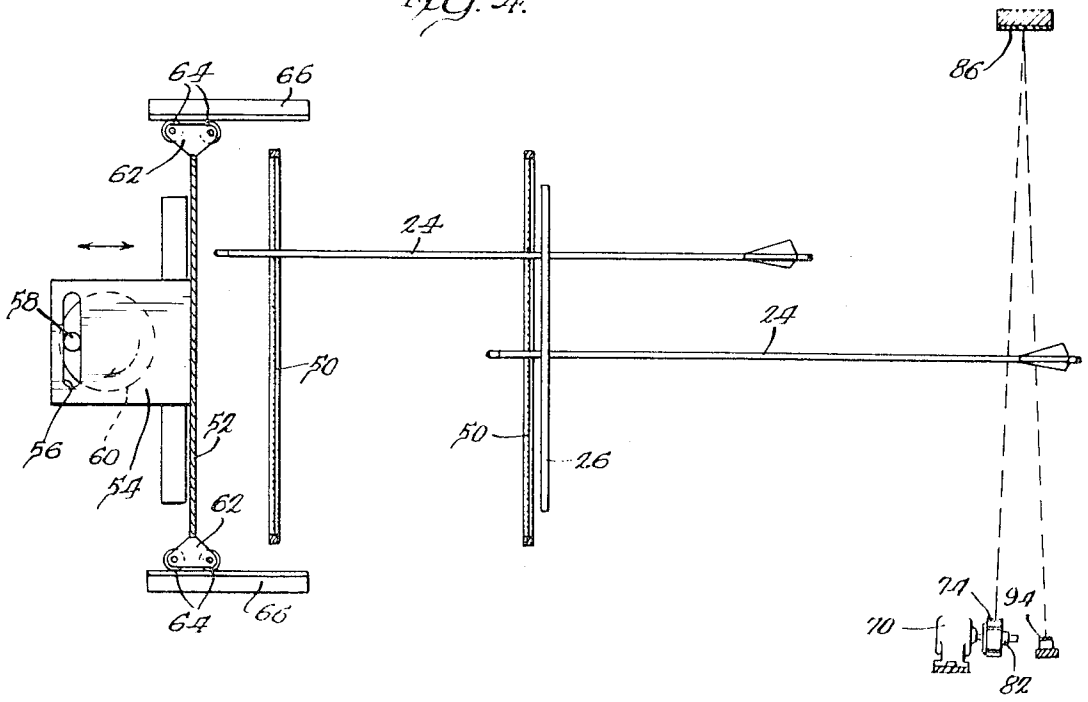
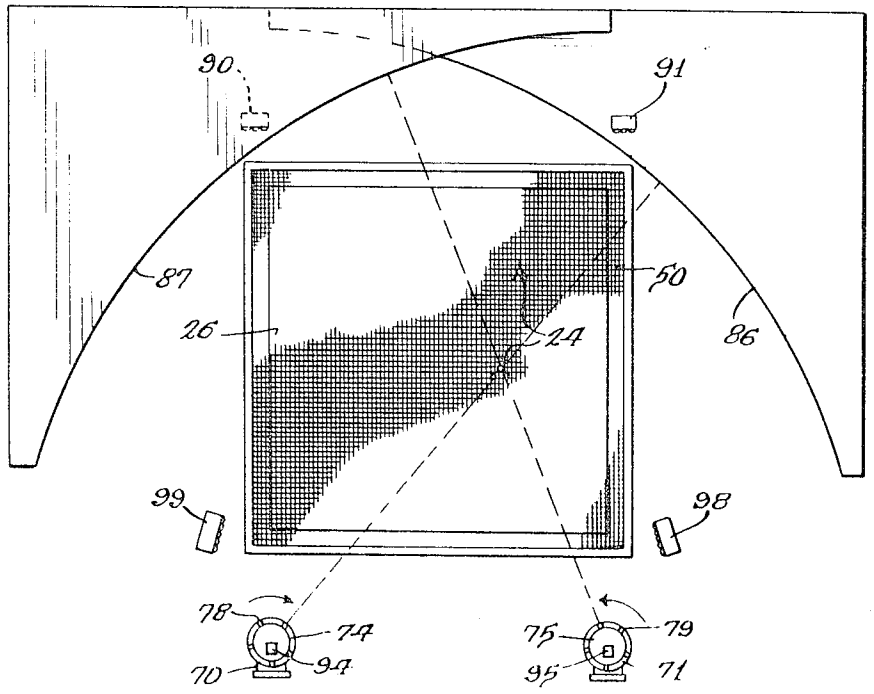

64
66
62
24
58
50
56
60
52
54
62
64
66
50
26
24
86
74
94
70
82

Fig. 5.


90
91
87
50
26
24
86
99
98
78
74
70
94
75
79
95
71

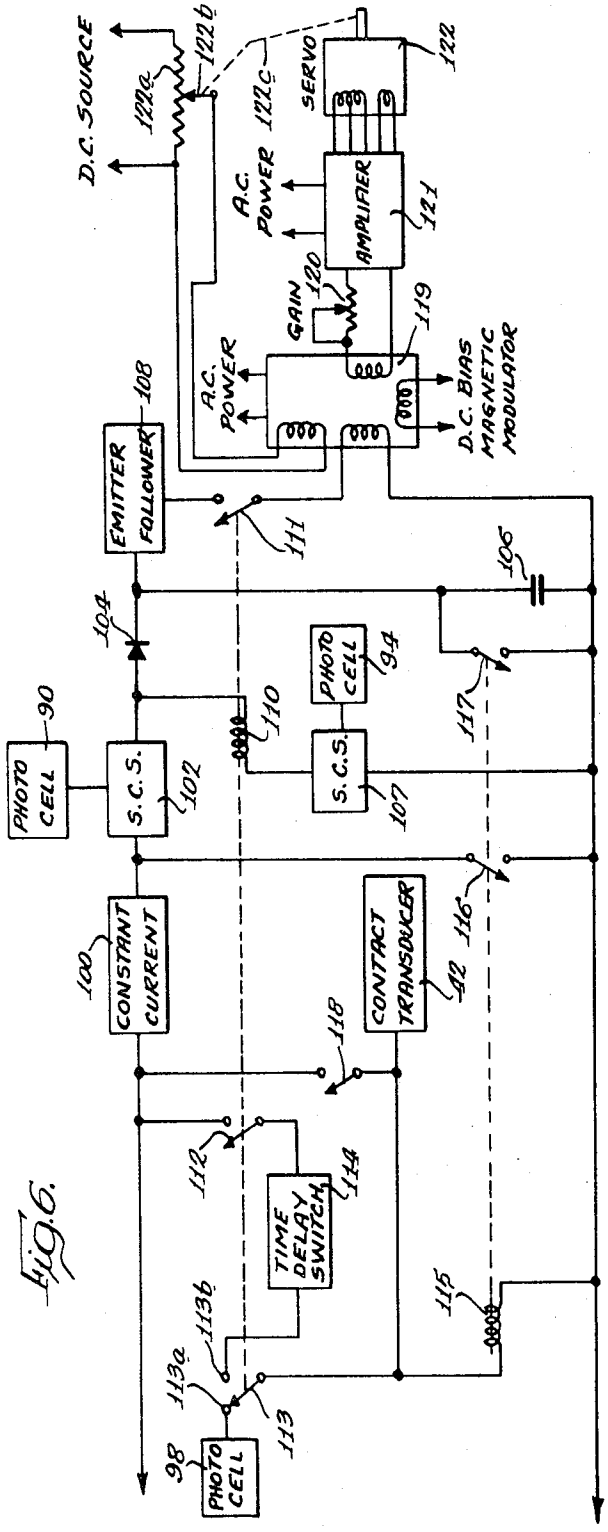

D.C. SOURCE
122a
122b
122c
SERVO
122
A.C. POWER
AMPLIFIER
121
GAIN
120
119
A.C. POWER
D.C. BIAS MAGNETIC MODULATOR
EMITTER FOLLOWER
108
111
106
104
PHOTO CELL
94
110
PHOTO CELL
90
S.C.S.
102
S.C.S.
107
117
CONSTANT CURRENT
100
CONTACT TRANSDUCER
92
116
118
112
TIME DELAY SWITCH
114
115
113a
113b
113
98
PHOTO CELL

Fig. 6.

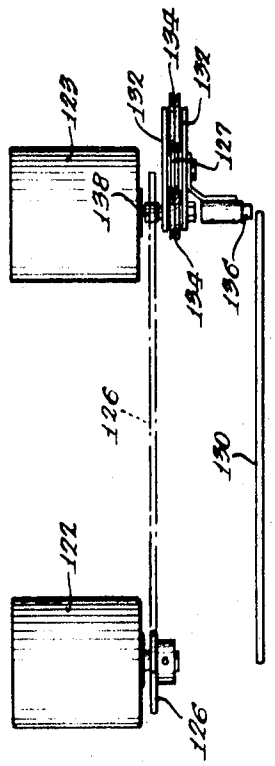

123
132
134
138
127
136
138
126
130
122
126

Fig. 7

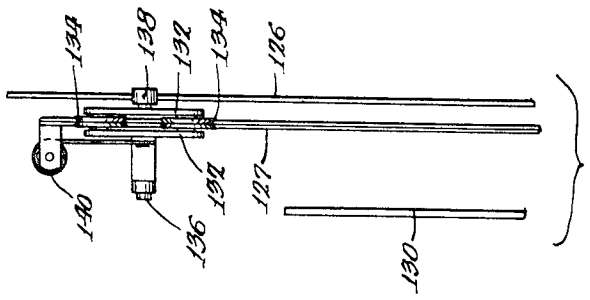

134
138
132
134
126
140
136
127
130

Fig. 9.

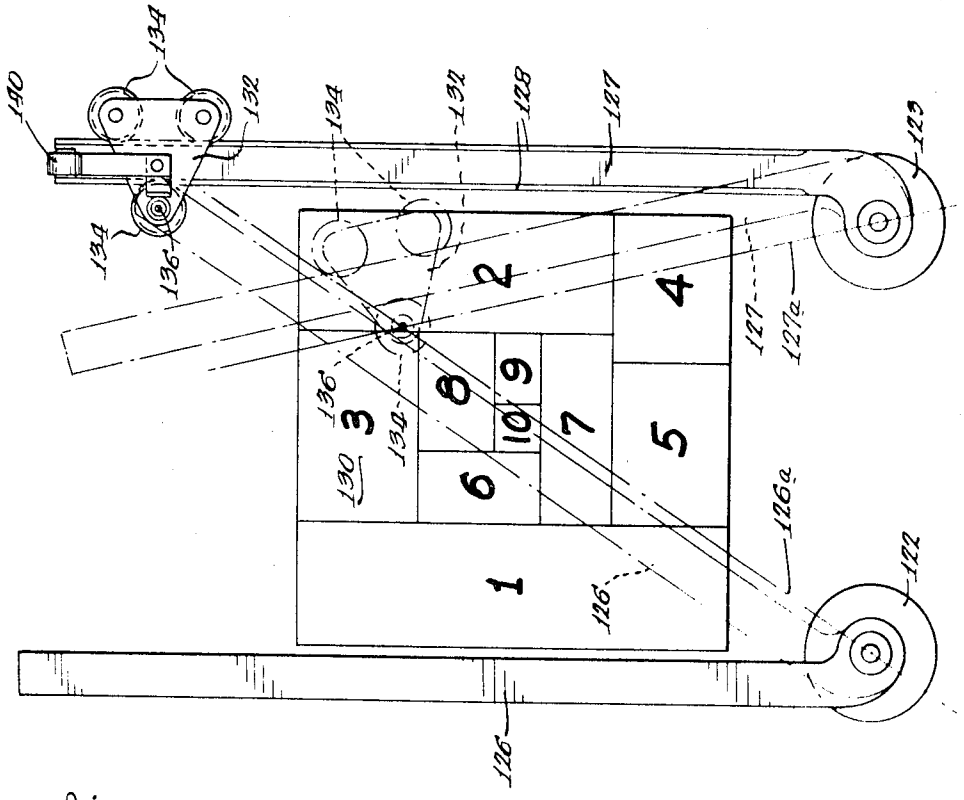

140
134
132
134
132
128
127
129
134
136
136'
130
130'
127
127a
126a
126'
122
126
1
2
3
4
5
6
7
8
9
10

Fig. 8.

ARROW HIT LOCATION INDICATOR

This application contains claims to nonelected subject matter disclosed in Rockwood et al. application Ser. No. 432,787, filed Feb. 15, 1965, now U.S. Pat. No. 3,401,937, issued Sept. 17, 1968.

An object of the invention, in general terms, is to provide a new and improved archery range.

Another object of the invention is to provide a novel archery game providing enjoyment for the archer and designed to maximize participation.

Another object of the invention is the provision of an improved target monitor in close proximity to the archer for indicating the point of contact of an arrow with the target wherein the target monitor indicator is operated by a servo mechanism in the scanning system so that exact placement of the arrow can be remotely determined by the archer such that placement of the next shot can be based on the result of the previous effort without interruption of the game.

Other objects of the invention will become readily apparent from the following detailed description taken in connection with the drawings wherein:

FIG. 1 is a longitudinal section through a preferred form of the invention, approximately along the line 1—1 of FIG. 2;

FIG. 2 is a transverse section of FIG. 1 taken approximately along the line 2—2;

FIG. 3 is another transverse section of FIG. 1 taken approximately along the line 3—3;

FIG. 4 is a side view of a preferred form of the backstop and scanning mechanism of the invention;

FIG. 5 is a front view of a backstop and scanning mechanism, used in a form of the invention;

FIG. 6 is a schematic diagram of a form of the scanning circuitry used in the invention;

FIG. 7 is a plan view of the scoreboard and associated indicating mechanism;

FIG. 8 is a front elevation of the scoreboard and associated indicating mechanism; and

FIG. 9 is a side view of a fragment of FIG. 8.

As shown schematically in FIG. 1, an archery range according to the invention includes a shooting station or firing line **20** manned by archer **22** firing arrows **24** at a target **26** spaced therefrom. Behind the target **26** is a self-ejecting backstop mechanism generally designated as **28**. Below the target **26** and the backstop mechanism **28**, is a collector **29** formed of a plate sloping forwardly and to one side as seen in FIG. 2. An arrow return mechanism is in close proximity to the collector **29** and comprises a pair of narrowly spaced belts **30***a*, **30***b* which feed to a conveyor **32** which in turn leads to an upwardly inclined pair of narrowly spaced belts **34***a*, **34***b*. The inclined belts **34***a*, **34***b* empty into a quiver, generally designated **36**, adjacent the archer **22**. A target monitor **38** is placed near the archer **22** for indicating arrow hits on the target **26**.

The target **26** may comprise the usual penetrable target sheets, having the desired target markings thereon, placed on the forward grid **50** of the backstop mechanism **28**. Preferably, however, the target **26** is formed of a facing of a self-healing nature as is well known in the art. The invention contemplates the use of a projector **27** for projecting suitable target markings onto the screen facing. In this way the projector **27** may be programmed with a number of different target marking which may be remotely selected for projection on the target by the archer.

The self-ejecting backstop mechanism **28** of the invention is illustrated in greater detail in FIG. 4. It comprises a pair of spaced grids **50**, backed by a movable plate **52** formed of any material sufficiently hard and thick to preclude penetration by the fired arrow and, yet able to absorb the kinetic energy of the arrow. On the upper and lower extremities of the plate **52** are mounted carriages **62** having wheels **64** on tracks **66**. The carriages **62**, wheels **64** and tracks **66** serve to movably mount the plate **52** for movement toward and away from the grids **50**. The mechanism for moving the plate **52** toward and away from the grids **50** comprises a member **54** attached to the back

of the plate **52** and having therein an elongated slot **56**. An eccentric pin **58** is received in the slot **56** and is rotated by a conventional one revolution motor **60**. Actuation of the one revolution motor **60** will result in the plate **52** reciprocating toward and away from the grids **50**. The apertures in the grids preferably comprise a high percentage of the total area of the grids so as to minimize the possibility of a direct hit of the solid portions of the grid by an arrow causing the arrow to bounce straight back towards the archer.

The invention also contemplates that the distance between the plate **52** in its "away" position and the forwardmost grid **50** or the target **26** is less than the distance between the tip of an arrow and the beginning of the fletching. When such spacing is used the fletching of the arrow never comes in contact with portions of the grid **50**, thus precluding damage to the fletching. Finally, the size of the apertures in the grids **50** are such as to loosely receive an arrow and to retain the arrow therein substantially only under the influence of gravity. Thus, a fired arrow, will lodge loosely in the apertures of the grids **50** after being brought to a halt by its contact with the plate **52**. At some predetermined time the one revolution motor **60** is actuated causing the plate **52** to move toward the grids **50**. This causes the arrows to be slidably ejected from the grids **50**. It will be appreciated that through suitable means, such as a transducer and a stepping switch, the backstop can be programmed to eject arrows after any predetermined number have been halted thereby. As stated previously, the target face and the forwardmost grid **50** are intended to be substantially coextensive. Thus, it will be seen that use of a backstop according to the invention results in the arrows partially protruding from the target where they may be observed by the archer until such time as plate **52** is actuated and the arrows are automatically ejected. Accordingly, this feature of the invention provides retention for observation purposes as well as for automatic ejection.

Placed about the arrow flight path, as a safety feature, is deflector **40**. Depending on the shape of the target **26**, the walls of the deflector **40** may take the shape of a truncated pyramid as shown in FIG. 1, or the frustum of a cone. Associated with the deflector walls **40** is a contact transducer **42** or a microphone of sufficient sensitivity to determine when the deflector walls **40** have been hit by an arrow **24**. Through conventional wiring such as a relay, the signal induced can be made to preclude operation of the scanning circuit and to show up on the target monitor **38** has a miss, thus informing the archer **22** that his last shot has been misdirected. This feature is necessary as the deflector walls **40** are arranged to deflect the arrow into the backstop **28** past the scanning mechanism and such a shot would show up as a score unless the fact that it has previously hit the deflector **40** is somehow indicated to the archer **22**.

To enable the archer **22** to be constantly aware of his score with each arrow shot, a target monitor **38** is arranged in close proximity to the archer as seen in FIG. 1. By means of a mechanism described below, the target monitor **38** indicates to the archer where his last arrow has hit the target. To feed appropriate signals to the target monitor **38** to indicate the location of the arrows corresponding to the hits on the target **26**, the invention provides a scanning mechanism generally designated **25** located ahead of the target **26**. As shown more clearly in FIGS. 4 and 5, this scanning mechanism comprises a pair of systems, each system being identical with the other, wherein one system determines one angular coordinate of the position of the arrow within a flight path and the other system determines another angular coordinate of the position of the arrow within the flight path. Since the two systems are identical, only one will be described in detail. It should be noted that as used herein, the term "flight path" refers to the general area, both in front of and behind the target **26**, in which arrows are intended to be fired, as contrasted to the line of flight taken by any given arrow.

An arcuate mirror **86** (see FIGS. 4 and 5) is placed about the periphery of the flight path near the target **26**. At the focal

point of the mirror is placed a light source providing a rotating beam of light. This function is achieved by means of an electric motor 70 rotating a drum 74 having equally spaced apertures 78 in its periphery. Mounted within the drum 74 is a light source 82. A first photocell 90 is disposed along an edge of the flight path so as to be energized by the rotating light beam as it begins its sweep across the flight path. A second photocell 94 is disposed at the focal point of the mirror adjacent the light source in such a position as to be energized by the light beam upon reflection of the beam by the mirror 86 at all times during the sweep of the light beam across the flight path. In order to accommodate the placing of both the light source and the second photocell at the point of the mirror, both are slightly inclined to the vertical but in opposite directions (see FIG. 4) such that a light beam reflected from the mirror will not retrace its path back to the source, but will diverge slightly therefrom and strike the second photocell. A third photocell 98 is disposed along another edge of the flight path in such a position as to be energized by the light beam upon completion of its sweep across the flight path. By this arrangement, it is apparent that the first photocell 90 will be energized only at the beginning of the sweep of the light beam across the flight path, and that the third photocell 98 will be energized only at the end of the sweep of the light beam across the flight path. By virtue of reflection of the light beam by the mirror 86, it is apparent that the second photocell 94 will be energized continuously throughout the sweep of the light beam across the flight path until the beam is interrupted at some point in that sweep. This interruption occurs when an arrow 24 passes through the flight path. Of course, in order for this sensing means to be effective, the time required for a single sweep of the beam across the flight path must be less than the time taken by an arrow in passing wholly through a plane perpendicular to its line of flight. For example, if it is considered that the shortest arrow commonly used is of a length of 24 inches, and the maximum velocity of the arrow upon reaching the target is 350 feet per second, then it is apparent that the time for the sweep must be no longer than one one-hundred and seventy-fifth of a second. Accordingly, a drum 74, having five equally spaced apertures 78 must be rotated at 2100 r.p.m. in order to achieve a sweep time for one beam of one one-hundred and seventy-fifth of a second. Obviously, however, other combinations of arrow lengths, drum speeds and number of apertures in the drum can be used.

The signals from the various photocells are transformed into a reading on the target monitor 38 by the following means. With reference to FIG. 6, one embodiment of the invention for transforming the signals comprises a scanning circuit connected to a source of electrical power and having a constant current generator 100. The constant current generator 100 is connected to a first silicon control switch 102, (a silicon control rectifier used as a switch), which is controlled by the first photocell 90. Connected in series with the silicon control switch 102 across the source of electrical power is a diode 104 and a condenser 106. Connected in parallel with diode 104 and the condenser 106, is a second silicon control switch 107 which is controlled by the second photocell 94, and a low impedance relay coil 110. Since silicon control rectifiers when used as switches begin to conduct only when stimulated by a positive pulse, and the second photocell 94 is arranged to be constantly energized except when an arrow is present as described above, it is necessary that the polarity of the connection of the second photocell 94 to the silicon control switch 107 be inverted, such that a positive pulse is fed to the silicon control switch 107 by the second photocell 94 when the latter is deenergized.

An emitter follower 108 is connected to the junction of the diode 104 and the capacitor 106. The emitter follower 108 serves to read the voltage across the capacitor 106 at any given time with insignificant discharging of the capacitor 106. This signal is in turn fed to a servomechanism in a manner as will be hereinafter described.

The relay coil 110 operates a pair of single throw switches 111 and 112, and a single-pole double-throw switch 113 having a normally closed contact 113*a* and a normally open contact 113*b*. The switch 111 is placed between the output of the emitter follower 108 and the servo mechanism. The switch 112 is placed in a series circuit with a time delay switch 114 and the normally open contact 113*b* of switch 113 and a reset relay coil 115 across the source of electrical power. The time delay switch 114 is arranged such that when switch 112 is closed and switch 113 is closed across contact 113*b* electrical current will flow to the reset relay coil 115 after a predetermined time period has passed. The third photocell 98 is connected to the contact 113*a* such that when switch 113 is closed through contact 113*a* the third photocell 98, when energized, will energize the reset relay coil 115. Additionally, the contact transducer 42 on the deflector 40 is arranged to energize the reset relay 115 if the deflector is hit by an arrow.

A normally open shorting switch 116 is closed by action of the reset relay 115 and is arranged across the power source from the junction of the constant current generator 100 and the first silicon control switch 102. A second normally open shorting switch 117, also operated by the reset relay 115, is arranged across the capacitor 106. Since the system must operate rapidly, the relays preferably are comprised of reed switches or the like.

As mentioned previously, the output of the emitter follower 108 is fed through the switch 111 when the latter is closed to a servomechanism. The servomechanism comprises a magnetic modulator 119 of conventional construction which converts the DC input signal to an alternating current signal. Preferably, on appropriate leads, a DC bias is placed on the magnetic modulator 119 so as to achieve a linear response in the servomechanism. The output of the magnetic modulator 119 is fed to a gain potentiometer 120 and then to a servoamplifier 121 which may be of conventional construction. The amplifier 121 is then connected to a conventional servomotor 122. Associated with the output of the servomotor 122 is a variable resistor 122*a* connected across a suitable DC source. The wiper 122*b* of the resistor 122*a* is linked by suitable means 122*c* to the servomotor 122 and is moved therewith when the motor 122 responds to an input signal. Through appropriate leads the resulting signal from the resistor 122*a* is fed back to the modulator 119 and is arranged to balance the input signal when the servomotor 122 has fully responded thereto to preclude further movement thereof. The operation of the circuit in conjunction with the target monitor 38 will be described hereinafter.

FIGS. 7, 8 and 9 show the mechanism by which the arrow position is indicated on the target monitor 38. The target monitor 38 comprises a translucent facing 130 bearing indicia, corresponding to that on the target 26, mounted in front of the indicating mechanism. The indicating mechanism includes a pair of servomotors 122 and 123, each operated by one system of scanning mechanism 25. The servomotor 122 mounts an arm 126 which is adapted to rotate across the translucent facing 130 to the position dictated by its scanning circuit. The servomotor 123 is mounted adjacent an opposite corner of the translucent facing 130 and also mounts a similar arm 127. The arm 127 supports an indicating lamp 136 mounted on a movable carriage 132. The carriage 132 includes grooved wheels 134 mounted on tracks 128 on either side of the arm 127. The carriage 132 is spring-biased by a constant tension spring 140 toward the upper extremity of the arm 127. Mounted on one side of the carriage 132 and in line with the longitudinal axis of the indicating lamp 136, is a cam follower 138 arranged in the path of the arm 126. As will be noted in FIG. 8, the arms 126 and 127 are slightly offset from parallel lines, 126*a* and 127*a* respectively, intersecting the center of rotation of their respective servomotors. The position of the indicating lamp 136 and the cam follower 138 on the carriage 132 is such that the lamp 136 will be located at the intersection of the parallel line for each arm when the carriage is moved under the influence of the two arms 126 and 127. This construction as-

sures that the lamp **136** will always be positioned at the exact angle of interception of the arrow regardless of its position with respect to the lengths of the two arms **126** and **127**.

The operation of the scanning and indicating mechanism is as follows: Again, since the respective scanning and indicating mechanisms for each of the two coordinates of the arrow hit upon the target **26** are the same, the operation of only one will be described. Initially, the capacitor **106** has a "zero" charge. As the beam of light begins its sweep across the flight path, the first photocell **90** is energized which supplies a short pulse to the first silicon control switch **102**. This causes the silicon control switch **102** ro conduct and to be locked "on." The capacitor **106** is then charged linearly by the constant current generator **100** through the diode **104**. If during the sweep of the light beam across the flight path, an arrow is present, the second photocell **94** is momentarily deenergized and by virtue of its reversed polarity connection to the second silicon control switch **107**, the latter receives a positive pulse, begins to conduct and is also locked "on." Accordingly, relay **110** is energized closing switches **111**, **112** and moving the switch **113** to the contact **113***b*. Because of the low impedance of relay **110**, the constant current generator **100** is effectively shorted out. This precludes the capacitor **106** from charging further, while the diode **104** precludes the capacitor **106** from discharging through the second silicon control switch **107**. With the closing of the switch **111**, the voltage on the capacitor **106** is applied through the emitter follower **108**, to the magnetic modulator **119** where it is transformed into an alternating current signal, to the amplifier **121**, and thence to the servomotor **122** which responds accordingly, moving its arm across the translucent facing **138**. Thus, when the servomotors **122** and **123** are actuated by signals from their respective scanning circuits, they respectively move the arms **126** and **127** to positions across the translucent facing **130** corresponding to the angles of interception of the arrow. The camming action of arm **126** on the cam follower **138** of the carriage **132** forces the indicating lamp **136** to one of the appropriate coordinates corresponding to the arrow hit on the target, while the movement of the carriage **132** by arm **127** positions the indicating lamp **136** at the other coordinate of the arrow hit on the target. At this point, the lamp **136** indicates through the translucent facing **130** and the indicia thereon, the position at which the arrow hit the target **26**. This position will be held until the device is reset by the time delay switch **114**.

Simultaneously, with the closing of switch **112** and the moving of switch **113** to contact **113***b*, which takes the third photocell **98** out of the circuit to prevent premature energization of reset relay **115**, the time delay switch **114** is energized and after a predetermined time period will energize reset relay coil **115**. Upon the energization of reset relay coil **115**, shorting switches **116** and **117** are closed. The closing of the shorting switch **116** diverts the current from the two silicon control switches **102** and **107**, which then revert to an "off" status. This action additionally stops the flow of current through relay **110** causing switches **111** and **112** to open and switch **113** to move back to the contact **113***a*, which takes the servomechanism and the time delay switch, respectively, out of the circuit. Simultaneously, with the closing of shorting switch **116**, shorting switch **117** is closed thereby shorting out the capacitor **106** and reducing the charge thereon to zero. The system is now ready for the next arrow.

If no arrow is present in the flight path, the capacitor **106** is charged as before. In this case, the third photocell **98** will be momentarily energized by the beam of light ending its sweep across the flight path, which will energize relay **115** through the normally closed contact **113***a* of switch **113**, thereby closing shorting switches **116** and **117**. Again, the first silicon control switch **102** is turned "off" and the capacitor **106** has its charge reduced to zero, thus readying the system for the next arrow. Additionally, if desired, a manually operated switch **118** can be placed in the circuit to selectively energize the reset relay **115** to reset the system. Should an arrow strike the deflector **40**, the control transducer **42** will energize the reset relay **115**.

It will be apparent from the foregoing that the capacitor **106** acts as a timer, measuring the time from the beginning of the sweep of the beam light across the flight path to the time at which the beam of light is broken by an arrow in terms of the voltage of its charge. It will be additionally noted that the presence of the time delay switch **114** is required to permit the servomechanism to respond to the charge across the capacitor **106** and to permit an archer or spectators to visually observe the resulting indication on the target monitor **38**.

It will be apparent that a scanning system according to the invention, such as that detailed above, provides great advantages over the sensing systems of the prior art. Because the system does not rely on mechanical or actual physical contact with the arrow passing through the target as do prior art devices, there is no arrow injuring contact and the sending of the position of the arrow as it passes within the flight path and through the target with means according to the invention is significantly more accurate. This is particularly true where the arrow hits the boundaries between adjacent target areas. Devices of the prior art, in such situations, either indicate that both target areas have been hit by an arrow or rely on a complex system of electronic circuitry which arbitrarily decides that the arrow has hit one area or the other. By way of contrast, when a scanning system according to the invention is used, the point at which the arrow hits the target need only be ascertained visually on the target monitor by the archer and scored in accordance with the established rules governing hits on target area boundaries. Thus, when a conventional method of scoring an archery game is used, the target sensing and indicating means according to the invention provide a significantly greater degree of accuracy in scoring than is obtainable with prior art devices.

Briefly, the overall operation of the range is as follows. The archer **22** steps to the firing line **20** and fires an arrow **24** at the target **26**. Just prior to the hitting of the target **26** by the arrow **24**, the arrow **24** passes through the scanning mechanism **25** causing the scanning circuitry and servo mechanism to respond in the manner previously described to indicate the point of entry of the arrow into the target **26** to the archer **22** or spectators on the target monitor **38**. The arrow **24** hits the target **26**, passes partially through the grids **50**, is stopped by the plate **52** of the backstop **28**, and comes to rest lying loosely within the grids **50** to be observed by the archer.

The score of the shot is recorded and the scanning system is then reset either automatically by the time delay switch **114** or by manual operation of switch **118**. Additional arrows **24** may then be fired as desired, causing the above sequence to be repeated. At some point, the backstop **28** will have received its programmed number of arrows **24** and will automatically eject the arrows **24** onto the collectors **29**. From the collectors **29**, the arrows **24** will be transported without injury thereto by the belts **30***a*, **30***b*, **32**, **34***a*, **34***b* to the firing line **20** and deposited in the quiver **36** to be held in readiness for the archer **22**.

Of course, it will be appreciated that the use of an automated range according to the invention takes much of the danger and drudgery out of archery. Additionally, while not being limited thereto, such a range is particularly well suited for the playing of an archery game such as that described hereinafter, as well as for league play because of the timesaving automation thereof and the various features providing ready adaptability to various target arrangements and combinations of the number of arrows to be fired.

To facilitate the rapid changing of target indicia by an archer or the use of moving target indicia, a suitable optical system (not shown) in conjunction with the projector **27** or a second projector **39** may be used to project a corresponding image on the target monitor **38**.

We claim:

1. An indicating divide comprising: a face adapted to have markings thereon, a first servomotor mounted adjacent the periphery of said face and operatively connected to a first arm, a second servomotor mounted adjacent the periphery of said face and spaced from said first servomotor; a second arm operatively connected to said second servomotor and mount-

ing a movable carriage; said carriage being provided with a visible indicator for movement across said face, and means associated with said carriage and said first arm for moving said carriage on said second arm thereby moving said indicator to a position on said face dictated by the response of said servomotors to an input signal.

2. The invention of claim 1 wherein constant tension means are provided for biasing said carriage to an extremity of said second arm.

3. An indicating device adapted to be energized by a remotely generated input signal comprising: face means for receiving indicia arranged in at least two dimensions; servo means for receiving said input signal and responding thereto, said servo means comprising at least two servomotors; movable means operatively associated with each of said servomotors for movement adjacent said face means by said servomotors in response to an input signal; and indicating means operatively associated with said movable means for indicating a point having at least two coordinates on said face means.

4. In an apparatus for indicating the location of a projectile hit in a target, an indicator face bearing a target pattern, an indicator element adapted for movement about the indicator face, a first arm pivotally mounted adjacent the indicator face to swing across the pattern area, a second arm pivotally mounted adjacent the indicator face to swing across the pattern area, means for moving the indicating element as a function of movement of both arms, and means for driving the arms.

5. In an apparatus for indicating the location of a projectile hit in a remote target as a function of two angular coordinate measurements of hit sensing means associated with the target, an indicator face bearing a target pattern, an indicator carriage adapted for movement about the indicator face, a light on the carriage to indicate a hit location relative to the target pattern, a first arm pivotally mounted adjacent the indicator face to swing across the area of the pattern, a second arm pivotally mounted adjacent the indicator face to swing across the pattern area to positions intersecting the first arm, means mounting the indicator carriage on one of said arms to move angularly with the arm and to move longitudinally along the arm, means biasing the carriage in one direction along the arm on which it is mounted, cooperating cam and follower means on the carriage and the other arm for moving the carriage along the mounting arm in opposition to the biasing means, a first electric motor connected to drive the first arm as a function of one coordinate measurement, and a second electric motor connected to drive the second arm as a function of a second coordinate measurement.

6. In an apparatus for indicating the location of a projectile hit in a target as a function of two coordinate measurements, an indicator face bearing a target pattern, an indicator carriage movable about the indicator face and having an element to indicate a hit location relative to the target pattern, a first arm pivotally mounted adjacent the indicator face to swing across the pattern area to represent one coordinate measurement, a second arm pivotally mounted adjacent the indicator face to swing across the pattern area to positions intersecting the first arm to represent a second coordinate measurement, means mounting the carriage on one of the arms for movement controlled by both arms to positions adjacent the intersection of the arms, and separate means for driving the arms variable angular distances.

7. A combination as defined in claim 6 where the means for driving the arms includes a first motor connected to drive the first arm as a function of one coordinate measurement and a second motor connected to drive the second arm as a function of a second coordinate measurement.

8. A combination as defined in claim 6 including means biasing the carriage along said one arm, and cooperating cam and follower means on the carriage and other arm controlling the position of the carriage along said one arm.

9. A combination as defined in claim 8 wherein said biasing means comprises a spring having one end connected to the outer end of said one arm and the other end connected to the carriage to urge the latter outwardly along said one arm.

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