GOLF PRACTICING APPARATUS

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ABSTRACT

A golf practicing apparatus includes a platform; a target mounted on the platform for receiving practice of golf shots; a display panel for indicating distance information, hook-slice information, and push-pull information; and electronic circuitry responsive to movement of the target for actuating the display panel. The target comprises a simulated golf ball and a stem which are supported for rotation about a first axis extending through the ball and the stem, a second axis extending perpendicularly to the first axis, and a third axis extending perpendicularly to the second axis and in the plane of the first axis. In operation, the speed of rotation of the target about the second axis is sensed to provide distance information, the direction and amount of rotation of the target about the first axis is sensed to provide hook-slice information, and the direction and amount of rotation of the target about the third axis is sensed to provide push-pull information. Rotation of the ball and stem about the first axis is detected by an assembly including a cam and conventional automobile breaker point assemblies. Rotation about the second axis is detected by a system including a lamp assembly, a phototransistor, and a rotatable opaque shutter including two spaced apart holes which permit two sequential light pulses to reach the phototransistor. Rotation about the third axis is detected by a system including a lamp assembly and a rotatable opaque shutter which uncovers one or more phototransistors arranged in a V-shaped array.

29 Claims, 14 Drawing Figures
FIG. 7

FIG. 8

FIG. 12
FIG. 11

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GOLF PRACTICING APPARATUS

BACKGROUND AND SUMMARY OF THE INVENTION

This invention relates to a golf practicing apparatus, and more particularly to a device for analyzing practice golf shots in terms of distance information, hook-slice information and push-pull information.

It has long been realized that it would be advantageous to be able to practice golf shots in confined areas and/or in inclement weather. To this end, numerous attempts have been made at designing a workable golf practicing apparatus. However, notwithstanding the fact that considerable time and effort have been expended in this regard, most of the golf practicing devices that are presently commercially available exhibit numerous disadvantageous characteristics.

For example, most prior art golf practicing devices include a simulated golf ball mounted for impact by a golf club, and structure for generating information as to how far a real golf ball would travel in response to the same impact. Typically, the simulated golf ball is returned to the same orientation after each shot, so that the same "side" of the simulated golf ball receives each impact. This causes rapid deterioration of the impact receiving side of the simulated golf ball.

Another problem that is often encountered in the use of prior art golf practicing devices is the rapid deterioration of the sensing mechanism. Heretofore, it has been common either to connect the sensing mechanism directly to the simulated golf ball, or to mount the sensing mechanism for impact by the simulated golf ball. In either case, the sensing mechanism is subject to repeated shocks, vibrations, etc., and is therefore extremely susceptible to damage.

Still another disadvantage in the use of many prior art golf practicing devices relates to the inability of such devices to provide a complete analysis of a practice golf shot. Early golf practicing devices were equipped to provide distance information only. Somewhat later, golf practicing apparatus capable of determining both how far a real golf ball would have traveled and the extent to which it would have been hooked or sliced were provided. Only very recently has there been any attempt to design a golf practicing apparatus capable of providing all of the information that is necessary for the complete analysis of a golf shot, i.e., distance information, hook-slice information and push-pull information.

The present invention comprises an improved golf practicing apparatus which overcomes the foregoing and other disadvantages that are characteristic of the prior art. In accordance with the preferred embodiment of the invention, a target includes a simulated golf ball mounted for impact by a golf club, and a stem fixed to the simulated golf ball. The target is supported for rotation about a first axis which extends through the ball and the stem, about a second axis which extends perpendicular to the plane of the first axis and a third axis which extends perpendicular to the second axis and within the plane of the second axis. The invention further comprises structure for measuring the speed of rotation of the target about the second axis and circuitry for generating a distance indicative signal in response thereto, and structure for measuring both the amount and the direction of rotation about the first and third axes and circuitry responsive to the latter measurements for generating error signals. Preferably, additional circuitry is provided for altering the distance indicative signal whenever rotation about either the first or the third axis is detected.

DESCRIPTION OF THE DRAWINGS

A more complete understanding of the invention may be had by referring to the following Detailed Description when taken in conjunction with the accompanying drawings, wherein:

FIG. 1 is a perspective view of a golf practicing apparatus incorporating the present invention;
FIG. 2 is a top view of the display panel of the golf practicing apparatus shown in FIG. 1;
FIG. 3 is an illustration of the assembly sequence of the golf practicing apparatus;
FIG. 4 is a longitudinal sectional view illustrating the target of the golf practicing apparatus;
FIG. 5 is a bottom view taken generally along the line 5-5 in FIG. 4 in the direction of the arrows;
FIG. 6 is a top view of the target of the golf practicing apparatus;
FIG. 7 is a side view taken generally along the line 7-7 in FIG. 6;
FIG. 8 is an end view taken generally along the line 8-8 in FIG. 6;
FIG. 9 is a schematic illustration of a portion of the distance display circuitry of the invention;
FIG. 10 is a schematic diagram of the nonlinear distance computation circuitry of the invention;
FIG. 11 is a block diagram of the distance display circuitry of the invention;
FIG. 12 is a graph illustrating the nonlinear relationship between the displayed distance and the pulses representative of time which are generated by the circuitry shown in FIGS. 9 and 10;
FIG. 13 is a schematic diagram of the push-pull computation and display circuitry of the invention, and
FIG. 14 is a schematic diagram of the hook-slice and subtraction computation and display circuitry of the invention.

DETAILED DESCRIPTION

Referring now to the drawings, and particularly to FIG. 1 thereof, there is shown a golf practicing apparatus 20 incorporating the present invention. The golf practicing apparatus 20 comprises a platform 22 which preferably is of suitable size and construction to support a golfer. A target 24 is mounted in the platform 22 and is normally positioned for impact by a conventional golf club that has been driven by a golfer standing on the platform 22. Following such an impact, distance information, hook-slice information and push-pull information concerning the practice golf shot is indicated on a display panel 26. The golf practicing apparatus 20 may also be provided with a conventional coin box 28, whereby money must be paid before the golf practicing apparatus 20 can be operated. It will be appreciated, however, that the coin box 28 may be replaced with a conventional on-off switch, if desired.

The display panel 26 of the golf practicing apparatus 20 is shown in greater detail in FIG. 2. The display panel 26 includes a distance scale 30 comprising a series of individual segments 32. A lamp is positioned behind each segment 32, and selected lamps are actuated following impact of the target 24 by a golf club to indicate the distance that a conventional golf ball would have traveled in response to an identical impact. The
display panel 26 further includes a hook scale 34, a slice scale 36, a push scale 38, and a pull scale 40. Each of the scale 34-40 includes three segments 42, and an individual lamp is positioned behind each segment 42. Following the impact of a golf club with the target 24, one or more of the segments 42 of one or more of the scales 34-40 may be illuminated to indicate the extent to which a real golf ball would have been hooked or sliced in response to an identical impact, and/or the extent to which the practice golf shot was pushed or pulled.

The assembly sequence of the golf practicing apparatus 20 is illustrated in FIG. 3. Initially, a frame 44, a plurality of stringers 46, and a bottom 48 are assembled to form a base 50. The display panel 26 comprises a plate 52 which receives a lamp harness 54, and a cover 56 which is mounted on the plate 52. Similarly, the target 24 comprises a pivot assembly 58 which is mounted on a yoke 60, and a housing 62 which receives the yoke 60. Thereafter, the display panel 26 and the target 24 are mounted in the base 50 and are combined with the coin box 28, a plurality of electronic circuit cards 64 and a power supply 66. The golf practicing apparatus 20 is completed by joining a steel plate 68 and a rubber pad 70 to a top 72, mounting a strip of artificial grass 74 on the top 72 to form a cover assembly 76, and then mounting the cover assembly 76 on the base 50 to complete the platform 22.

The structural details of the target 24 of the golf practicing apparatus 20 are illustrated in FIGS. 4 through 8. Referring particularly to FIG. 4, the pivot assembly 58 of the target 24 comprises a simulated golf ball 78 and a stem 80 which extends from the simulated golf ball 78 to a pair of bearings 82. The simulated golf ball 78 and the stem 80 comprise a length of wire rope 84 having a pair of steel plugs 86 swaged to its opposite ends, and a cover 88 which may be formed from polyurethane, or the like. The bearings 82 are mounted in a cross shaft 90 and support the simulated golf ball 78 and the stem 80 for free rotation about a first axis 92 extending axially through the simulated golf ball 78 and the stem 80, and through the pivot point 94.

As is best shown in FIGS. 4 and 6, the cross shaft 90 is supported in the yoke 60 by a pair of bearings 96. The bearings 96 permit rotation of the simulated golf ball 78, the stem 80, the bearings 82 and the cross shaft 90 about a second axis 98 which extends through the pivot point 94 and perpendicular to the first axis 92. A spring 100 is connected between the cross shaft 90 and the yoke 60 and functions to provide a restoring force which returns the target to a position illustrated in FIG. 1 following impact of the target by a golf club.

Referring now specifically to FIG. 6, the yoke 60 comprises a U-shaped member 102 which supports the bearings 96, and a cylindrical shaft 104 which supports the U-shaped member 102. The housing 62 is supported between two of the stringers 46 of the base 50 and includes a mounting block 106. The mounting block 106 receives the shaft 104 and supports the yoke 60, the bearings 96, the cross shaft 90, the bearings 82, the stem 80, and the simulated golf ball 78 for rotation about a third axis 108 which extends through the pivot point 94 perpendicular to the second axis 98, and in the plane of the first axis 92.

From the foregoing, it will be understood that the target 24 of the golf practicing apparatus 20 comprises a simulated golf ball mounted for rotation about first, second, and third axes. In the operation of the golf practicing apparatus 20, rotation of the simulated golf ball 78 about the axes 92, 98 and 108 is employed to generate hook-slice information, distance information, and push-pull information, respectively. More particularly, the speed of rotation of the simulated golf ball 78 about the second axis 98 is employed to generate distance information, the direction and amount of rotation of the simulated golf ball 78 about the first axis 92 is employed to generate hook-slice information, and the direction and amount of rotation of the simulated golf ball 78 about the third axis 108 is employed to generate push-pull information.

Referring now to FIGS. 6 and 7, a shutter 110 is secured to the end of the cross shaft 90 remote from the spring 100. The shutter 110 has a pair of holes 112 and 114 formed in it and is positioned in a slot 116 extending between a lamp assembly 118 and a phototransistor 120. The shutter 110 is opaque, and normally functions to prevent the passage of light between the lamp assembly 118 and the phototransistor 120. However, upon impact of the simulated golf ball 78 by a golf club, the simulated golf ball 78 and the stem 80 pivot clockwise (FIG. 7) about the second axis 98 until the simulated golf ball strikes an impact damper 122. During this action, the passage of light between the lamp assembly 118 and the phototransistor 120 is permitted, first through the hole 112, and subsequently through the hole 114. The phototransistor 120 generates an output pulse whenever light is permitted to pass to it from the lamp assembly 118 and the elapsed time between the two pulses that are generated by the phototransistor 120 following impact of the simulated golf ball 78 by a golf club is measured to determine the speed of rotation of the simulated golf ball 78 about the second axis 98.

Referring now to FIG. 5, a circular plate 124 is secured to the bottom of the cross shaft 90, and an octagonal cam 126 is secured to the bottom of the stem 80 for rotation therewith about the first axis 92. A pair of conventional automobile breaker point assemblies 128 and 130 are mounted on the plate 124 and are positioned for actuation by the cam 126. It will be noted that whereas the breaker point assembly 128 is mounted in alignment with the second axis 98, the breaker point assembly 130 is offset with respect to the axis 98. Because of this positioning, the breaker point assemblies 128 and 130 cooperate to generate a combined output which is indicative of both the direction and the amount of rotation of the simulated golf ball 78 about the first axis 92.

Referring now to FIGS. 6 and 8, the shutter 132 is secured to the shaft 104 of the yoke 60 for rotation therewith about the third axis 108. The shutter is positioned in a slot 134 formed between a lamp assembly 136, and a phototransistor array 138. As is best shown in FIG. 8, the phototransistor array 138 includes six phototransistors 138a-138f which are positioned in a V-shaped array. The shutter 132 is opaque, and normally prevents the passage of light between the lamp assembly 136 and the phototransistor array 138. However, upon rotation on the shutter about the third axis 108, one or more of the phototransistors 138a-138f is uncovered, and by this means an output indicative of both the amount and the direction of rotation of the simulated golf ball 78 about the third axis 108 is generated.
Referring now to FIGS. 9-14, the electrical circuitry of the invention is illustrated. The electrical circuitry is connected between the target movement sensing structure previously described and the display panel 26 in order to visually indicate distance information, hok-slice information, and push-pull information. Referring now to FIG. 9, the phototransistor 120 is connected to an input of an AND gate 150. The output of the gate 150 is connected through an inverter 152 to a control terminal of a flip-flop 154. The Q terminal of the flip-flop 154 is connected to a flip-flop 156 and also to an input of a NAND gate 158. The second input of the NAND gate 158 is connected to a free running oscillator 160 comprising series connected inverters 162 and 164, a potentiometer 166, an inverter 168 and a capacitor 170. The oscillator 160 generates a series of clock pulses at about 500 KHz which are applied to the input of the gate 158. The potentiometer 166 may be varied in order to vary the frequency of the oscillator 160.

The output of the gate 158 is connected to the input of a register 172, the output of which is applied upon a series of terminals 174a-d. The output 174d is applied to the input of a second register 176. The register 176 includes output terminals 178a-d. The output terminal 178 of the register 176 is connected to the input of a third register 180. Registers 172, 176 and 180 comprise, for example, Model 8281A 4-bit counters manufactured and sold by Signetics. In the operation of the circuitry thus described, the phototransistor 120 generates a pulse each time one of the holes 112 or 114 in the shutter 110 become aligned with the light beam from the lamp assembly 118. These pulses are applied through the gate 150 which provides a smoothing action to the rising voltage of the phototransistor 120. The inverter 152 inverts the pulse and applies the pulse to the flip-flop 154 which then toggles. The Q output of the flip-flop 154 goes high for a prescribed period upon the interception of the first pulse in a cycle from the phototransistor 120. This high state allows the clock pulses from the oscillator 160 to be applied through the gate 158 to the register 172 which then stores counts from the oscillator 160. Upon reception of the second pulse from the phototransistor 120 due to the passage of the hole 114 through the light beam from the lamp assembly, the Q output from the flip-flop 154 goes low to turn the NAND gate 158 off. The count thus stored in the registers 172, 176 and 180 is inversely proportional to the velocity of the target 24.

When the Q output of the flip-flop 154 goes low, the flip-flop 156 is toggled. The Q output of the flip-flop 156 goes low to thus provide an inhibit signal which is applied via a terminal 190 to the inhibit circuitry shown in FIG. 13. The Q output from the flip-flop 156 is also applied via a lead 192 to the input of a NAND gate 194. The Q output of flip-flop 156 is connected via a lead 196 to inputs of the AND gate 150 in order to inhibit operation of the distance determining circuitry for the remainder of a cycle. In effect, the gate 150 is allowed to only pass two pulses from the phototransistor 120 until a suitable reset signal is applied in the manner to be subsequently described. The Q inhibit signal from the flip-flop 156 is also applied to terminal 198 for application to the hook-slice determining circuitry of the invention which is shown in FIG. 14.

The Q output from flip-flop 156 is applied to a oneshot multivibrator 200 which operates to control the reset circuitry of the invention. The output of the multivibrator 200 is applied to the second input of the NAND gate 194, the output of which is applied through an inverter 202 to provide a reset signal to the push-pull circuit shown in FIG. 13 via a terminal 204. The output of gate 194 is also connected to the inputs of a NAND gate 206 which provides an output which is applied through a trio of inverters 208, 210 and 212. A reset signal is thus applied from the gate 206 via a terminal 214 to the subtract circuitry shown in FIG. 14. A reset signal is applied from the inverter 208 which is applied to the hook-slice circuit shown in FIG. 14 via a terminal 216. A reset signal is applied from the output of the inverter 210 to the subtract circuitry shown in FIG. 14 via a terminal 218. A reset signal is applied from the output of the inverter 212 to the distance display circuitry shown in FIG. 11 via a terminal 220.

The output from the oscillator 160 is also applied via a lead 230 to the input of a NAND gate 232, the output of which is connected via a terminal 234 to the circuitry shown in FIG. 10. The second input of the gate 232 is connected to the terminal 236 to receive subtract pulse signals from the subtract circuit shown in FIG. 14.

The output of the gate 232 is connected to an input of a NAND gate 240, the output of which is connected to the inputs of a NAND gate 242. The output of the gate 242 is applied to a terminal 244 for application to the display circuitry shown in FIG. 11. The second input of the gate 240 is connected to a terminal 246 to receive an inhibit signal from the circuitry shown in FIG. 10.

The outputs of the register 180 are interconnected as shown to the inputs of a pair of inverters 250 and 252, a pair of NOR gates 254 and 256, and a NAND gate 258. The output of gate 254 is connected through a NOR gate 260 to a terminal 262 for connection to the circuitry shown in FIG. 10. The output of the gate 256 is fed through an inverter 264 to a terminal 266 also for application to the circuitry shown in FIG. 10. The output of the gate 256 is also fed to the inputs of a NOR gate 268, the output of which is applied to a terminal 270 for application to the circuitry shown in FIG. 10. The output of the gate 258 is connected to a terminal 272 for application to the circuitry shown in FIG. 10. The output of the NAND gate 258 is connected through a NAND gate 280 to a terminal 282 for application of the gated clock pulse signals to the distance computation circuitry shown in FIG. 10.

The outputs from the register 172 are applied via the terminals 174a-d to an inline decoder 300 shown in FIG. 10. The outputs from the register 176 are applied via the terminals 178a-d to a second inline decoder 302. Referring to FIG. 10, the inline decoders 300 and 302 decode the binary outputs from the registers 172 and 176 into decimal data. Suitable inline decoders for use as circuits 300 and 302 are Model SN74154 decoders manufactured and sold by Texas Instruments Incorporated of Dallas, Tex. The decoded outputs from the decoders 300 and 302 are interconnected to the inputs of various ones of 24 NOR gates 304a-x. The outputs of the gates 304a-1 are connected through inverters 306a-1, the outputs of which are tied to the terminal 246. The outputs of the gates 304m-x are connected through inverters 306m-x to the terminal 234. The counts in the registers 172 and 176 are inversely proportional to the velocity of the target 24. The circuitry shown in FIG. 10 decodes this data to provide output
signals proportionally representative of the distance that a real golf ball would travel in response to the same impact that was applied to the golf ball. The graph shown in FIG. 12 represents the relationship between the number of pulses applied to the decode circuitry of FIG. 10 and the distance in yards that a real golf ball would travel. As an example, 1,023 counts applied to the decode circuitry is representative of a distance of 100 yards, while a count of 310 counts is representative of 330 yards of travel. The circuitry shown in FIG. 10 is interconnected to provide outputs representative of distance in accordance with the graph shown in FIG. 12. A synchronizing signal for the system is applied from the circuitry shown in FIG. 9 via a terminal 282.

The counts are derived by the decode circuitry in the following manner. As an example, a logic high upon the terminal 270 is representative of 256 counts. Six counts are added from terminal 7 of the decoder 300, while 48 counts are derived from terminal 4 of the decoder 302. The respective inputs to the gate 304a are thus representative of 256 + 6 + 48, which equals the 310 counts required to be counted by the system before the gate 304a generates a true output through the inverter 306a for application to the display circuitry. The remainder of the gates 304b-x are operated in a similar manner to provide predetermined count logic operation according to the curve shown in FIG. 12.

The gates 304b-x go true when additional pulses are stored in the registers. A series of normally spaced output pulses are thus provided on the terminals 246 and 234 which are applied to the inputs of a summing NAND gate 240 shown in FIG. 9. The output of the gate 240 is inverted by the gate 242 and is applied to a distance display register 310 shown in FIG. 11 via the terminal 244. The register 310 is connected in series with a second register 312 and a third shift register 314. The registers 310 and 312 comprise 10-bit shift registers such as the Model 8202 shift registers manufactured and sold by Signetics. The register 314 comprises a 4-bit shift register such as the Model 8271 register manufactured and sold by Signetics. The registers 310-314 are initially set to zero at the beginning of a cycle through a push-3 signal 220 from the reset circuit. As the distance pulses arrive via the terminal 244, voltage is shifted down through the registers.

The outputs of the register 310 are applied to respective ones of a series of transistor lamp drivers 316a-e while the outputs of a shift register 312 are applied to a series of transistor lamp drivers 316f-j. The four outputs from the shift register 314 are applied to a series of transistor lamp drivers 316k-1. The lamp drivers 316a-i may comprise the Model SN75451 lamp drivers manufactured and sold by Texas Instruments Incorporated. Each of the lamp drivers controls the operation of a pair of lamps. The lamp transistor lamp drivers 316a-l thus control the operation of a series of lamps 318a-x. The lamps 318a-x are disposed underneath the individual segments 32 of the display panel 26 shown in FIG. 2 in order to provide a visual indication of the distance imparted to the target 24. For example, the lamp 318b would be illustrated to provide an indication of a drive of 100 yards, while the lamps 318a-x would be illuminated to indicate an indication of a drive of 150 yards. All of the lamps 318a-x would be illuminated to indicate a drive of 330 yards.

The shift registers 310-314 are not shifted until a threshold count of 310 is reached by the circuitry shown in FIG. 10. The lamp drivers 316a-l are normally disabled so that none of the lamps 318a-x are normally illuminated. During an operational cycle of the system, the registers 310-314 store the counts provided by the circuitry shown in FIGS. 9 and 10. After the count applied to the registers 310-314 is terminated, none of the lamps 318a-x is yet energized due to the fact that a signal applied to terminal 320 maintains each of the lamp drivers 316a-l in a nonenergized condition. The lamp drivers 316a-l are maintained in the off condition until a subtract signal is applied from the subtract circuitry, as will be later described. After the reception of the subtract signal, selected lamp drivers 316a-l are energized in order to illuminate the desired lamps.

A reset signal is applied to the distance display circuitry via a terminal 220. The one-shot multivibrator 200 shown in FIG. 9, which may comprise either a 7 or a 10 second period one shot, automatically generates a reset signal for resetting all of the flip-flops and registers of the system to zero after the completion of the cycle.

Referring now to FIG. 13, the push-pull circuitry of the invention will be described. The push-pull phototransistor array 138, previously described with respect to FIG. 6, generates output signals in response to movement of the shutter 132. When the shutter 132 is rotated out of the beam of light emanating from the lamp assembly 136, respective ones of the phototransistors in the array 138 are energized to generate electrical output signals. Each of the transistors in the array 138 are connected to a respective one of the three input AND gates 350-360 shown in FIG. 13. The output of the gate 350 is applied to an input of a NOR gate 362. The gate 362 is interconnected with a NOR gate 364 in a latch configuration. Gate 364 receives at one input the reset signal applied via the terminal 204 from FIG. 9. The output of gate 362 is applied to an input of a transistor lamp driver 366 for control of a lamp 368a. The output of the gate 364 is connected to a terminal 370b to provide an indication of the pull-2 signal.

The output of an AND gate 352 is applied to a pair of latch interconnected NOR gates 372. The output of one of the gates being connected to control the transistor lamp driver 366 for control of the lamp 368b. The output of the second one of the gates 372 is connected to a terminal 370b to provide an indication of the pull-2 signal. Similarly, the output of gate 354 is connected to a pair of latch interconnected NOR gates 374, one of the outputs thereof being connected to a transistor driver 376 for control of the operation of a lamp 368c. The other output of the gate 374 is connected to a terminal 370c for an indication of a pull-1 signal. Latch interconnected gates 378 operate to control the operation of a lamp 380a and provide a signal via a terminal 382a representative of a pull-1 signal. Latch interconnected NOR gates 384 control the operation of a transistor lamp driver 386 for control of the energization of a lamp 380b. The gates 384 also provide an output signal via a terminal 382b representative of the push-2 signal. Latch interconnected NOR gates 388 operate the lamp driver 386 for control of a lamp 380c and generate a signal via a terminal 382c representative of the push-3 signal. Interconnected NOR gates 374 also provide a signal via a terminal 390 representative
Gates 374 provide a signal via a lead 394 to the input of a NAND gate 396, the output of which is applied to the inputs of a trio of gates 356, 358 and 360. Gates 378 are connected via a lead 398 to a NAND gate 400, the output of which is connected to inputs of the gates 350, 352 and 354. An inhibit signal is applied from the circuitry shown in FIG. 9 via a terminal 190 to a NAND gate 402, the output of which is applied to a terminal 404 for connection with the circuitry shown in FIG. 14. The output of a gate 402 is also connected to inputs of each of the gates 350–360. An inhibit signal from the circuitry shown in FIG. 9 is applied through the terminal 198 to an input of a one-shot multivibrator 406, the output of which is connected to an input of the gate 402.

In operation of the push-pull circuitry shown in FIG. 13, the phototransistor array 138 generates output signals which are applied to the gates 350–360 representative of the magnitude of the push or pull force imparted to the target 24. The transistor lamp drivers 366, 376 and 386 are thus controlled to selectively energize one of the lamps 368a–c to indicate the three various stages of a pull, while lamps 380a–c are selectively energized to indicate the magnitude of push imparted to the target. A reset signal applied to terminal 204 resets the NOR gates to zero after the completion of a cycle of operation. The gates 396 and 400 provide a feedback inhibit signal so that bouncing of the target 24 does not provide the opposite of a push or pull as an indication, an allows only the initial indication of a push or pull to be visually indicated.

The signals applied to the terminals 370a–c, 382a–c, 390 and 392 are applied to the circuitry shown in FIG. 14 for utilization in the subtract portion of the system. The inhibit signals applied to the terminals 190, 198 and 404 operate to inhibit further operation after a pre-selected time interval.

Referring to FIG. 14, the hook-slice display circuitry and the subtraction circuitry is illustrated. The breaker point assemblies 128 and 130 are closed in the manner previously described in order to indicate the hook-slice movement of the target 24. The breaker point assemblies 128 and 130 are offset from one another in order to indicate the direction of rotation of the target 24 around the first axis 92. In operation of the breaker point assemblies, one of the assemblies is designated as a reference switch. When the output from the switch is high and the output from the second switch makes a negative transition, one direction of rotation is indicated. When the reference switch output is low and the second switch makes a negative transition, the opposite direction of rotation is indicated.

While the breaker point assemblies 128 and 130 have been illustrated for use in one embodiment of the invention, it should be understood that other, preferably nonmechanical sensing devices could be utilized with the system. For instance, magnetic pickups/or electro-optics could be utilized in place of the breaker point assemblies 128 and 130.

The two breaker point assemblies 128 and 130 are connected to inputs of a pair of AND gates 420 and 422, respectively. The gates 420 and 422 smooth up the transition signals from the breaker point assemblies to provide a smooth output signal. The output of the gate 420 is applied to the inputs of a NAND gate 424, the output of which is connected through an AND gate 426 to an input of a NAND gate 428. Logic from the circuitry shown in FIG. 9 is applied to an input of gate 426 from the terminal 198. The output of the gate 422 is also applied to an input of a gate 428. The number of pulse outputs from the gate 422 are applied to a 4-bit counter 430 for counting. The output of the counter 430 is applied through a binary to 16 decoder 432 which may comprise for example, a Model SN74154 decoder manufactured and sold by Texas Instruments Incorporated.

The output from the decoder 432 is applied through either PRO or AMATEUR outputs from the decoder 432. Switches are provided to select either the PRO or the AMATEUR outputs for selection of the amount of hook or slice which is displayed. The output from the decoder 432 is applied to the inputs of a series of NAND gate latch circuits 434, 436, and 438. The output of gate 428 is applied to a NAND gate latch configuration 440. The outputs of the latches 434–440 are applied to respective ones of a series of the NAND gates 442–452. The outputs of the gates 442 and 444 are applied to a dual transistor lamp driver 454 which controls the operation of a hook-1 lamp 456 and a hook-2 lamp 458. The outputs of the gates 446 and 448 are applied through a dual transistor lamp driver 460 for control of a hook-3 lamp 462 and a slice-1 lamp 464.

The outputs of the gates 450 and 452 are applied through a dual transistor lamp driver 466 to control of a slice-2 lamp 468 and a slice-3 lamp 470. Outputs from each of the transistor lamp drivers 454, 460 and 466 are also applied to a terminal 474 for application of the circuitry shown in FIG. 11 for control of the distance display circuitry. The hook-slice lamps 456, 458, 462, 464, 468 and 470 are located underneath the segments 42 of the hook-slice display 34 of the display panel 26.

In operation of the hook-slice circuit, when the gate 428 goes true in response to one direction of rotation of the target 24, a hook of the target 24 is indicated. The latch 440 thus goes true to enable the gates 442, 446 and 448 to go high in response to an output from the decoder 432. The output from the decoder 432 determines which of the lamps 456–462 are energized, with a low count energizing only the lamp 443 to illuminate only the lamp 456, and with a high count energizing each of the latches 434–438 to energize each of the lamps 456, 458 and 462. Conversely, if the gate 428 does not go true, a slice is indicated and the gates 448 and 452 are prepared for indication of a slice. The magnitude of the value stored in the decoder 432 then determines which of the latches 434–438 are energized to control the energization of the slice lamps 464–470.

Referring again to FIG. 14, the subtract portion of the circuitry will now be described. The outputs from gates 442–452 are applied through a plurality of inverters 500–510 for application to inputs of a plurality of exclusive OR gates 512–522. Push and pull indicators derived from the circuitry shown in FIG. 13 are applied through the terminals 382a–c and 370a–c to the gates 512–522. The interconnections of the gates 512–522 are made according to the fact that a push tends to negate a hook, while a pull tends to negate a slice of the target 24. Therefore, the exclusive OR gates 512–522 tend to compensate a slice and a pull, or a hook and a push. That is, if a hook-1 and a push-1 signal are pres-
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tent, no output appears from the gate 512. However, if only a hook signal is applied to the gate 512, a high output is applied to a shift register 530 for storage. Similar logic applies for gates 514 and 522.

The outputs of the gates 512–518 are stored in a register 530, while the outputs of gates 520 and 522 are stored in the register 532. The outputs from the register 530 are applied to terminal 236 for application to the distance display circuit shown in FIG. 9. The signals are summed at the gate 532. As the subtract pulses are negative, the pulses tend to subtract from the final magnitude display by the distance lamps 318a–x.

Hook and slice signals are also applied to a NAND gate 550, the output of which is connected to a transistor lamp driver 552 which controls the operation of a flag lamp 554 and a green lamp 556. If no push or pull is applied to the target 24, the gate 550 goes low to enable the lamp driver 552 to illuminate the flag lamp 554. If a push or pull is applied to the target 24, the lamp 554 will not be illuminated. If no push or pull is applied to the target 24, and an indication is received on a terminal 560 from the distance circuitry shown on FIG. 11 indicating that the target has been hit with an impact sufficient to drive a real golf ball 330 yards, exclusive OR gates 562 operate through a NAND gate 566 to cause the green lamp 556 to become illuminated. If the target is not hit at least 330 yards, or if the target is not hit straight, the green lamp 556 will not be illuminated.

A delayed inhibit signal is fed to the terminal 404 from the circuitry shown in FIG. 13 to a one-shot multivibrator 570. The Q output of the multivibrator 570 is connected to registers 530 and 532. The Q output of the multivibrator 570 is applied to the inputs of a pair of NAND gates 572 and 574. A reset pulse is applied via a terminal 218 from the circuitry shown in FIG. 9 to an input of a NAND gate 576. The gate 576 is interconnected in a latch configuration with the gate 572. A clock signal from the oscillator 160 shown in FIG. 9 is applied via a terminal 580 to one of the inputs of the gate 574. The output of the gate 574 is interconnected with the registers 530 and 532. The output of the gate 576 is connected to the light emitting device 318.

In operation, the one-shot multivibrator 570 provides a predetermined amount of time for the push-pull circuitry to settle prior to the initiation of the subtraction operation. After settling of the push-pull circuitry, a light enable signal is applied via a lead 584 to shift data into the shift register 530, while the latch arrangement comprising the gates 572 and 576 provides clock shift pulses via a lead 586 to the registers 530 and 532. When the latch comprising the gates 572 and 576 true, a light enable signal is applied via the terminal 320 which goes back to the circuitry shown in FIG. 11 to enable the energizing of the distance indicating lamps 318a–x.

It will thus be seen that the present invention provides a golf practicing apparatus which visually displays accurate information with regard to the distance, hook or slice, and the push or pull forces that are imparted to the target 24. The present golf practicing apparatus is extremely reliable in operation, due to the manner of detection of target motion, and also due to the use of solid state circuitry in the computation and display portions of the system. The present golf practicing system provides an accurate indication of the actual distance which is imparted to the ball target by the use of the subtraction circuitry of the invention which subtracts when the ball is hooked, sliced, pushed or pulled. In addition, the present invention includes circuitry which compensates for various combinations of hook-slice and push-pull with respect to the distance computation. The reset and enable circuitry of the present system prevents false indications due to bouncing or other movement of the target after the initial impact. Finally, the mounting of the simulated golf ball for free rotation about the first axis, and the use of remote sensing to detect movement about the second and third axes results in a golf practicing apparatus that is extremely durable and trouble-free in operation.

Although the preferred embodiment of the invention has been illustrated in the accompanying Drawings and described in the foregoing specification, it will be understood that the invention is not limited to the embodiment disclosed, but is capable of rearrangement, modification and substitution of parts and elements without departing from the spirit of the invention.

What is claimed is:

1. In a golf practicing method of the type in which a target is struck with a golf club, the improvement comprising:
   measuring the movement of the target about a first axis and generating a first error indicative output in response to the measurement;
   measuring the speed of movement of the target about a second axis that extends perpendicular to the first axis and generating a distance indicative output in response to the measurement, and
   measuring the movement of the target about a third axis that extends perpendicular to the second axis and generating a second error indicative output indicative of the distance in response to the measurement.

2. The improved golf practicing method according to claim 1 wherein the first measuring step is further characterized by generating an output indicative of both the direction and the amount of rotation of the target about the first axis.

3. The improved golf practicing method according to claim 1 wherein the third measuring step is further characterized by generating an output indicative of both the direction and the amount of rotation of the target about the third axis.

4. The improved golf practicing method according to claim 1 including the additional step of altering the distance indicative output in response to the generation of either of the error indicative outputs.

5. A golf practicing apparatus comprising:
   a target supported for rotation about a first axis; a second axis which extends horizontally through the first axis, and a third axis which extends perpendicularly to and through the second axis;
   means for generating an output signal indicative of the speed of rotation of the target about the second axis;
   means for generating a first error signal indicative of rotation of the target about the first axis, and
   means for generating a second error signal indicative of rotation of the target about the third axis.

6. The golf practicing apparatus according to claim 5 wherein the output signal generating means comprises remote sensing means for measuring the speed of rotation of the target without physical attachment thereto.

7. The golf practicing apparatus according to claim 5 wherein the first error signal generating means com-
13. The golf practicing apparatus according to claim
5 wherein the second error signal generating means
comprises means for generating a second error signal
indicative of both the direction and the amount of rotation
of the target about the first axis.

8. The golf practicing apparatus according to claim
5 wherein the second error signal generating means
comprises means for generating a second error signal
indicative of both the direction and the amount of rotation
of the target about the third axis.

9. The golf practicing apparatus according to claim
5 further characterized by means responsive to the gen-
eration of either error signal for altering the output sig-
nal.

10. The golf practicing apparatus according to claim
5 wherein the means for generating an output signal
comprises:
means for generating first and second signals repre-
sentative of the passage of the target past prede-
termined fixed locations;
circuitry responsive to said first and second signals
for generating a sequence of clock pulses representa-
tive of the speed of passage of the target past said
fixed locations, and
means for converting said sequence of clock pulses
into a distance indicative signal proportional to
the speed of passage of the target.

11. The golf practicing apparatus according to claim
10 wherein said converting means comprises:
binary to decimal converting means for nonlinearly
converting said sequence of clock pulses into said
distance signal and register means for accumulat-
ing said distance signal.

12. The golf practicing apparatus according to claim
11 further comprising:
circuitry for subtracting from said distance signal in
response to either of said error signals, and
circuitry for inhibiting the display of said distance sig-
nal until the generation of one of said error signals.

13. The golf practicing apparatus according to claim
12 further comprising:
compensation circuitry for inhibiting the subtraction
from said distance signal upon the occurrence of
preselected combinations of said error signals.

14. A golf practicing apparatus comprising:
a simulated golf ball;
a stem fixed to the simulated golf ball and extending
therefrom to a pivot point;
first bearing means for supporting the stem for rota-
tion about a first axis extending through the ball,
the stem and the pivot point;
second bearing means for supporting the stem for rota-
tion about a second axis extending through the pivot
point and perpendicular to the first axis,
third bearing means for supporting the stem for rota-
tion about a third axis extending through the pivot
point and perpendicular to the second axis, and
means responsive to the speed of rotation of the ball
and the stem about the second axis for generating
a distance indicative output signal.

15. The golf practicing apparatus according to claim
14 further including means for generating an error sig-
als in response to rotation of the stem and the ball
about the first axis.

16. The golf practicing apparatus according to claim
15 further including means responsive to rotation of
the ball and the stem about the first axis for altering the
distance indicative output signal.
first and second locations, whereby the photosensitive means generates first and second signals indicative of the speed of rotation of the ball and the stem about the second axis.

23. The golf practicing apparatus according to claim 22 further characterized by:
circuitry responsive to said first and second signals for generating a sequence of clock pulses representative of the speed of rotation of the ball and stem past the first and second locations, and
means for converting said sequence of clock pulses into a distance indicative signal proportional to the speed of rotational of the ball and stem.

24. The golf practicing apparatus according to claim 23 wherein the shutter is opaque and has a pair of apertures formed through it, one for permitting the light beam to engage the photosensitive means as the ball and stem pass the first location, and the other for permitting the light beam to engage the photosensitive means as the ball and stem pass the second location.

25. A golf practicing apparatus comprising:
a target assembly including a simulated golf ball and a stem affixed thereto;
first bearing means for supporting the target assembly for free rotation about a first axis extending through the stem and the ball;
second bearing means for supporting the target assembly for rotation about a second axis extending perpendicular to the plane of the first axis;
means responsive to the speed of rotation of the target assembly about the second axis for generating a distance indicative signal, and
means responsive to rotation of the target assembly about the first axis for generating an error signal.

26. The golf practicing apparatus according to claim 25 further characterized by means interconnecting the distance indicative signal generating means and the error signal generating means for altering the distance indicative signal in response to the generation of an error signal.

27. The golf practicing apparatus according to claim 25 wherein the distance indicative signal generating means includes a member mounted for rotation with the target assembly about the second axis; remote sensing means detached from and responsive to the speed of rotation of the member for generating an output signal indicative of the speed of rotation of the member, and circuitry for receiving the output signal of the rotation responsive means and for converting such signal into a distance indicative display.

28. The golf practicing apparatus according to claim 25 wherein the error signal generating means is further characterized by means for generating an error signal indicative of the direction and the amount of rotation of the target assembly about the first axis.

29. The golf practicing apparatus according to claim 28 wherein the error signal generating means is further characterized by dual means each for detecting rotation of the target assembly about the first axis, said dual means being positioned at circumferentially spaced points about said axis, and circuitry responsive to the outputs of both of said dual means for generating an error signal indicative of the direction and the amount of rotation of the target assembly about the first axis.