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(54) **Golf ball with piezoelectric material**

Golfball mit piezoelektrischem Material

Balle de golf avec matériau piézoélectrique

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Description

BACKGROUND

[0001] The present invention relates to a golf ball containing piezoelectric material, and in particular to a system and method of obtaining golf ball data associated with hitting a golf ball containing piezoelectric material.

[0002] Increased awareness and proliferation of golf equipment designed for particular levels of play has led to advances in matching a golfer with an appropriate golf club. Similarly, with advances in golf ball design, there has been increased interest in matching a golfer with an appropriate golf ball.

[0003] Golf club fitting has become well known and a routine service of golf pro shops. Typically, a combination of information about a golfer's physical characteristics, such as height, arm length, gender, and age, and a golfer's swing characteristics, such as club head speed and angle of attack, are used to determine an appropriate club for a golfer.

[0004] Golf ball fitting is a newer process and generally uses a combination of subjective data gathered from a golfer questionnaire and objective swing characteristics, such as measurements of club head speed, ball speed, launch angle, angle of attack, backspin, side spin, and total distance.

[0005] In addition, golfers have an interest in tracking data associated with their golf swing and general golf play to accumulate historical data or to develop a golfer profile.

[0006] Therefore, there exists a need in the art for a method and system for obtaining golf ball data associated with hitting a golf ball. Specifically, a method and system that will allow a golfer to conveniently and easily obtain golf ball data associated with a golfer's swing that is useful for golf club fitting systems, goff ball fitting systems, and golfer profile databases.

[0007] Related prior art is disclosed in US 2003/228934 A1 and US 2009/003136 A1.

SUMMARY

[0008] In one aspect, the invention provides a golf ball comprising: a cover, a core, and a piezoelectric material portion, wherein the piezoelectric material portion is disposed between the cover and the core.

[0009] In another aspect, the invention provides a system for obtaining golf ball data, comprising: a golf ball with a piezoelectric material portion, a sensor for measuring an output associated with the piezoelectric material portion, and a detector in communication with the sensor for receiving the output measured by the sensor, wherein the detector uses the output to obtain golf ball data.

[0010] In an alternative, a method of obtaining hit golf ball data is provided, comprising: providing a golf ball with a piezoelectric material portion, measuring an output associated with the piezoelectric material portion when the golf ball is hit by a golf club, correlating the measured output associated with the piezoelectric material portion to known golf ball data to obtain hit golf ball data associated with the golf ball being hit by the golf club; and recording the hit golf ball data.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The invention can be better understood with reference to the following drawings and description. The components in the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention. Moreover, in the figures, like reference numerals designate corresponding parts throughout the different views.

[0012] FIG. 1 is an isometric view of a golfer at a test stand with a golf ball and golf club;

[0013] FIG. 2 is an isometric view of a close up of a golf ball at a test stand in proximity to a detector/receiver;

[0014] FIG. 3 is a cross-sectional view of different exemplary embodiments of golf balls with piezoelectric material;

[0015] FIG. 4 is an exploded view of an exemplary embodiment of a golf ball with a piezoelectric material layer provided with an internal transmitter and memory storage;

[0016] FIG. 5 is an isometric view of a golf ball with piezoelectric material about to be hit by a golf club;

[0017] FIG. 6 is an isometric view of a golf ball with piezoelectric material hit by a golf club;

[0018] FIG. 7 is an isometric view of a golf ball with piezoelectric material under deformation;

[0019] FIG. 8 is an isometric view of a golf ball with piezoelectric material after deformation;

[0020] FIG 9 is an isometric view of a golf ball with piezoelectric material transmitting a signal from an internal transmitter;

[0021] FIG. 10 is a cross-sectional view of an exemplary embodiment of signal transmission from a golf ball with piezoelectric material to a receiver;

[0022] FIG. 11 is a cross-sectional view of an exemplary embodiment of signal detection from a golf ball with piezoelectric material by a detector;

[0023] FIG. 12 is a cross-sectional view of an exemplary embodiment of signal transmission from a golf ball with piezoelectric material to a receiver;

[0024] FIG. 13 is a cross-sectional view of an exemplary embodiment of signal transmission from a golf ball with piezoelectric material to a receiver;

[0025] FIG. 14 is a flowchart of an embodiment of a method of generating an output in a piezoelectric material portion of a golf ball;

[0026] FIG. 15 is a flowchart of an exemplary embodiment of a method of obtaining data from an internal sensor in a golf ball;

[0027] FIG. 16 is a flowchart of an exemplary embodiment of a method of obtaining data by sensing an output from the piezoelectric material in a golf ball; and

[0028] FIG. 17 is a schematic view of different embodiments for using golf ball data.

DETAILED DESCRIPTION

[0029] An exemplary embodiment of a system for obtaining golf ball data associated with hitting a golf ball containing piezoelectric material is shown in FIGS. 1 and 2. In FIG.1, a test stand 100 including a receiver 106 can be provided for a golfer 102 to hit a golf ball 104 with a golf club 108. Test stand 100 can obtain golf ball data associated with the golf ball 104 when hit by the golfer 102 using receiver 106.

[0030] Referring to FIG. 2, test stand 100 is shown including golf ball 104 and golf club 108 disposed in proximity to receiver 106. Golf ball 104 contains a piezoelectric material, described more fully below, that upon impact with club face 200 of golf club 108, compresses to produce a measurable output. Receiver 106 can include an antenna 202 for receiving a signal associated with the measurable output. Based on the signal associated with the measureable output, the system can obtain golf ball data associated with hitting the golf ball.

[0031] Piezoelectric materials are a group of materials that generate an electric potential difference upon application of a mechanical force. In response to an applied force, a voltage is generated in the piezoelectric material that is proportional to the applied force. Similarly, the reverse effect is possible, where an applied voltage will generate a compressive force on the piezoelectric material. One very well known piezoelectric material is quartz, which is typically used in watches. Many other natural and synthetic materials are piezoelectric, including various crystals, ceramics, and polymers.

[0032] In one embodiment, the piezoelectric material is a piezoelectric polymer. In some cases, the piezoelectric polymer may include, but is not limited to: polyvinyl fluoride (PVF), polyvinylidene fluoride (PVDF), polyvinyl chloride (PVC), polytetra-fluorodethylene-polyvinylidene fluoride (PTFE-PVF2) and other polymers, copolymers, and ceramic polymer mixtures.

[0033] Generally, golf balls can be made in various configurations and can be composed of a variety of materials. Golf balls configurations may include, but are not limited to two piece, three piece, or four piece configurations. Each configuration includes a cover. In some cases, the cover material may include, but is not limited to urethane, balata, synthetic balata, Surlyn®, elastomer, and other materials. The inner composition of a golf ball may include a core, a mantle, and additional core or mantle layers, depending on whether the golf ball is a two piece, three piece, or four piece configuration. The inner composition of a golf ball may include a variety of materials including, but not limited to: natural rubber, balata, synthetic rubber, plastics, thermoplastics, polymers, elastomers, resins, and other materials and combinations of materials.

[0034] In one exemplary embodiment, the piezoelectric material portion may be injected into the golf ball. In some embodiments, the piezoelectric material portion may be a layer of the golf ball. In other embodiments, the piezoelectric material portion may be a film. In still other embodiments, the piezoelectric material portion may be solid material incorporated into the golf ball.

[0035] FIG. 3 illustrates different exemplary embodiments of a piezoelectric material portion disposed within a golf ball. In a first exemplary embodiment, a golf ball 300 may comprise a cover 302, a piezoelectric material portion 304, and a core 306. As shown in FIG. 3, piezoelectric material portion 304 may be disposed between cover 302 and core 306. In this embodiment, piezoelectric material portion 304 is disposed on the underside of cover 302. In some cases, piezoelectric material portion 304 may be disposed between or among any combination of the core, mantle, and additional core or mantle layers. In other cases, piezoelectric material portion 304 may comprise a layer of golf ball 300, including one or more of the core, mantle, and additional core or mantle layers. In other embodiments, piezoelectric material portion 304 may be disposed on the outside of cover 302. In still other embodiments, cover 302 of golf ball 300 may be composed of the piezoelectric material.

[0036] Referring to FIG. 3, in a second exemplary embodiment, a golf ball 320 may comprise a cover 322, a piezoelectric material portion 324, a core 326, an internal sensor 328, and a connecting lead 330. In this embodiment, internal sensor 328 may detect and measure the output from piezoelectric material portion 324 via connecting lead 330. In other embodiments, internal sensor 328 may not include a connecting lead to measure the output from piezoelectric material portion 324. In some cases, one or more of the core, mantle, and additional core or mantle layers of the golf ball may include conductive materials. In other cases, cover 322 of golf ball 320 may include conductive material.

[0037] FIG. 3 illustrates a third exemplary embodiment of a golf ball 340 including a cover 342, a piezoelectric material portion 344, a mantle 346, an internal sensor 348, a connecting lead 350, and a core 352. In this embodiment, internal sensor 348 may detect and measure the output from piezoelectric material portion 324 via connecting lead 350 passing through core 352 and mantle 346.

[0038] Referring to FIG. 3, in a fourth exemplary embodiment, a golf ball 360 may include a cover 362, a piezoelectric material portion 364, a core 366, an internal sensor 368, and a connecting lead 370. In this embodiment, internal sensor 368 is disposed in close proximity to piezoelectric material portion 364 along one section of golf ball 360. In other embodiments, internal sensor 368 may be disposed in golf ball 360 in a different relation to the piezoelectric material portion 364. In some cases, piezoelectric material portion 364 may be included in one section of golf ball 360. In some cases, indicia (not shown) on cover 362 of golf ball 360 may indicate the location of the section of golf ball 360 containing piezo-

electric material portion 364.

[0039] FIG. 3 illustrates a fifth exemplary embodiment of a golf ball 380 including a cover 382, a piezoelectric material portion 384, a mantle 386, an internal sensor 388, and a core 390. In this embodiment, internal sensor 388 is in contact with piezoelectric material portion 384. In some embodiments, indicia (not shown) on cover 382 of golf ball 380 may indicate the location of internal sensor 388 within golf ball 380.

[0040] FIG. 4 illustrates an exemplary embodiment of an internal sensor within golf ball 320. As shown in FIG. 4, golf ball 320 may include an internal sensor 328. In this embodiment, internal sensor 328 includes an antenna 400, a transmitter 402, and a data storage device 404. Internal sensor 328 may receive an output from piezoelectric material portion 324 via connecting lead 330 when golf ball 320 is hit by a golf club. In some cases, the output from piezoelectric material portion 324 may be a voltage. In other cases, the output from piezoelectric material portion 324 may be a current. In some embodiments, internal sensor 328 may include a processor or circuitry for measuring the output from piezoelectric material portion 324. A processor or circuitry for measuring voltage or current may be of any kind known in the art.

[0041] Referring to FIG. 4, in this embodiment, transmitter 402 may transmit the measured output from the piezoelectric material portion 324 to a receiver (not shown) via antenna 400. In one embodiment, data storage device 404 may record the measured output from piezoelectric material portion 324. In some embodiments, data storage device 404 may contain correlation information to correlate a measured output from piezoelectric material portion 324 to hit golf ball data. In other embodiments, data storage device 404 may permit internal sensor 328 to record multiple outputs from piezoelectric material portion 324 associated with more than one instance of golf ball 320 being hit.

[0042] FIGS. 5-9 illustrate a series of views of an exemplary embodiment of a golf ball with a piezoelectric material portion being hit by a golf club 108. Referring to FIG. 5, golf ball 320 with piezoelectric material portion 324 and internal sensor 328 is shown in proximity to a receiver 106. A golfer (not shown) swings golf club 108 towards golf ball 320. In FIG. 6, a club face 200 of golf club 108 makes contact with golf ball 320. As club face 200 makes contact with golf ball 320, kinetic energy is transferred from club face 200 to golf ball 320. Referring to FIG. 7, the kinetic energy transferred to golf ball 320 causes golf ball 320 to undergo a deformation. The deformation compresses piezoelectric material portion 324.

[0043] Referring to FIG. 8, the deformation of golf ball 320 and the compression of piezoelectric material portion 324 generates an electric charge in piezoelectric material portion 324. The output of piezoelectric material portion 324 may be sensed by internal sensor 328 contained inside golf ball 320. In some cases, the electric charge from piezoelectric material portion 324 sensed by internal sensor 328 may provide power to energize internal sensor 328. Referring to FIG. 8, in this embodiment, internal sensor 328 can measure the electric charge and correlate the measured charge to hit golf ball data. Hit golf ball data can include, but is not limited to: amount of deformation, angle of deformation, ball speed, backspin, sidespin, total spin, and other parameters associated with a golf ball.

[0044] As shown in FIG. 9, once internal sensor 328 has sensed the electric charge from piezoelectric material portion 324, internal sensor 328 can transmit the hit golf ball data to receiver 106. In one embodiment, a transmission 900 can be a radio frequency signal received by an antenna 202 of receiver 106. In other embodiments, the transmission may include optical, acoustic and other forms of communication with the receiver.

[0045] FIGS. 10-13 illustrate different exemplary embodiments of golf balls with piezoelectric material portions communicating with a receiver or detector. FIG. 10 illustrates an exemplary embodiment of golf ball 1000 including piezoelectric material portion 1004 and internal sensor 1008. Internal sensor 1008 may transmit a signal 1010 associated with a sensed output from piezoelectric material portion 1004 via a transmitter (not shown) using an outer surface 1006 of a golf ball cover material 1002 as an antenna. In some cases, outer surface 1006 may include conductive paint. In one embodiment, outer surface 1006 may include metallic paint. In other cases, golf ball cover material 1002 may contain conductive materials. Receiver 106 can include an antenna 202 for receiving signal 1010 from golf ball 1000.

[0046] Referring to FIG. 11, an exemplary embodiment of golf ball 1100 includes a piezoelectric material portion 1104. Compression of piezoelectric material portion 1104 when golf ball 1100 is hit by a golf club generates an electric charge 1106 in piezoelectric material portion 1104. Electric charge 1106 may be sensed by a detector 1112 disposed in proximity to golf ball 1100. In this embodiment, detector 1112 includes a magnetic field sensor 1110 for sensing a magnetic field 1108 associated with electric charge 1106 from golf ball 1100 as it moves after being hit. In other embodiments, detector 1112 may use other sensors for detecting an output from piezoelectric material portion 1104.

[0047] Referring to FIG. 12, another exemplary embodiment of a golf ball 1200 can include a piezoelectric material portion 1204 and an internal sensor 1206. In this embodiment, internal sensor 1206 may detect the output from piezoelectric material portion 1024 and transmit a signal 1210 associated with the detected output via a transmitter (not shown) using an internal antenna 1208. As shown in FIG. 12, receiver 106 includes an antenna 202 for receiving signal 1210 from golf ball 1200.

[0048] In another exemplary embodiment illustrated in FIG. 13, golf ball 1300 includes a piezoelectric material portion 1304 and an internal sensor 1306. In this embodiment, internal sensor 1306 includes an internal antenna 1308 and a data storage device 1310. Data storage device 1310 may store data from internal sensor 1306 gen-

erated when golf ball 1300 is hit by a golf club. In one embodiment, data storage device 1310 may be used to record data associated with a golfer hitting golf ball 1300 multiple times. In other embodiments, data storage device 1310 may be used to record data associated with a golfer hitting a golf ball, such as golf ball 1300, during play.

[0049] Golf ball 1300 can be placed in proximity to a golf ball data recording unit 1314 to induce transmission of a signal 1316 from golf ball 1300 containing hit golf ball data stored in data storage device 1310. In one embodiment, golf ball data recording unit 1314 may generate a magnetic field to induce piezoelectric material portion 1304 in golf ball 1300 to compress. The compression generates an electric charge in piezoelectric material portion 1304, which may be used to energize internal sensor 1306. In this embodiment, internal sensor 1306 may transmit a signal 1316 containing the hit golf ball data stored in memory storage 1310 via a transmitter (not shown) using internal antenna 1308. Golf ball data recording unit 1314 can receive signal 1316 via antenna 1312. In some embodiments, golf ball data recording unit 1314 may use RFID technology to communicate with golf ball 1300. In other embodiments, golf ball data recording unit 1314 may receive hit golf ball data from golf ball 1300 using any electromagnetic, optical, acoustic or other form of communication.

[0050] In an exemplary embodiment, golf ball data recording unit 1314 may include a processor. In various embodiments, golf ball data recording unit 1314 may be provided in various hardware and software configurations, including, but not limited to: a computer, a smart phone or other portable device including a processor, a terminal connected to a server over a network, and other hardware or software configurations for processing data.

[0051] FIG. 14 illustrates an exemplary embodiment of a method 1400 of generating an output in a piezoelectric material portion of a golf ball when hit by a golf club by a golfer. The order of the steps illustrated in FIG. 14 is exemplary and not required. In a first step 1402, a golfer hits a golf ball containing a piezoelectric material portion with a golf club. In a second step 1404, the golf ball deforms from the force of the impact with the golf club. In a third step 1406, the deformation caused by the force of the impact compresses the piezoelectric material portion in the golf ball. In step 1408, the compression of the piezoelectric material portion generates an electric charge that energizes the piezoelectric material portion of the golf ball. In step 1410, an output from the energized piezoelectric material portion is measured. In some embodiments, the output may be a voltage. In other embodiments, the output may be a current.

[0052] FIG. 15 illustrates an exemplary embodiment of a method 1500 of obtaining data from an internal sensor in a golf ball containing a piezoelectric material portion. The order of the steps illustrated in FIG. 15 is exemplary and not required. At a first step 1502, an internal sensor inside the golf ball detects an output from a piezoelectric material portion of the golf ball. The internal sensor may include circuitry to correlate the detected output from the piezoelectric material portion to hit golf ball data. In some cases, the circuitry could include a processor accessing a database containing known correlations between a measured output of a piezoelectric material and hit golf ball data. In other cases, the circuitry may include a circuit that multiplies the detected output from the piezoelectric material portion by a specified amount to correlate the output to hit golf ball data. Different circuitry may be provided that can correlate a detected output from a piezoelectric material to hit golf ball data. Hit golf ball data can include, but is not limited to: amount of deformation, angle of deformation, ball speed, backspin, sidespin, total spin, and other parameters associated with a golf ball.

[0053] In some embodiments, a correlation may be made between the output from a piezoelectric material and hit golf ball data. Because piezoelectric material generates an electric charge that is in proportion to the amount of impact force applied to the material, hit golf ball data can be correlated from knowledge of the impact force and the golf ball properties. In some cases, this correlation can be generated by using a golf swing robot to hit a golf ball of a known construction multiple times and gather measured data associated with the hit golf balls. Golf swing robots are well-known in the art, and any type of robot capable of consistently swinging a golf club according to a programmed set of instructions may be used. In some embodiments, the result can include a database containing known correlations between a measured output of a piezoelectric material and hit golf ball data. In other cases, a processor may be used to execute a program that can correlate the measured output of a piezoelectric material to hit golf ball data.

[0054] In one exemplary embodiment, the obtained hit golf ball data includes a ball speed and a spin rate. Ball speed is the measurement of the velocity of a golf ball after impact with a club head of a golf club. Because the output of the piezoelectric material is proportional to the force of the impact of the club head with the golf ball, the ball speed can be determined based on a measurement of the current detected in the piezoelectric material. The spin of a golf ball is the rotation of a golf ball while in flight. Spin includes rotation against the direction of flight, i.e., backspin, and rotation sideways to the direction of spin, i.e., side spin. Total spin is the vector addition of backspin and side spin. The spin rate of a golf ball is the speed that the golf ball rotates on its axis while in flight. Typically, the spin rate is measured in revolutions per minute (rpm). The spin of a golf ball is related to an amount of deformation of the golf ball. The amount of deformation of the golf ball can be determined based on the magnitude of the output of the piezoelectric material when compressed. Based on the amount of deformation, a spin rate can be determined. Various hit golf ball data may be obtained, including, but not limited to: amount of deformation, angle of deformation, ball speed, spin rate, backspin, sidespin and other parameters associated with a

golf ball.

[0055] Referring to FIG. 15, at a second step 1504, the internal sensor transmits the hit golf ball data via a transmitter according to one or more embodiments discussed above. In some cases, the internal sensor may be energized by the output from the piezoelectric material portion. In other cases, the internal sensor may include an energy storage device, such as a battery or capacitor. At a third step 1506, the transmitted hit golf ball data from the internal sensor may be received by a detector. Referring to FIG. 15, once the hit golf ball data is received, the ball data may be recorded by a golf ball recording unit. In some embodiments, the recording unit may be included with the detector. In other embodiments, the golf ball recording unit may be a separate unit in communication with the detector. The detector may be any one or more embodiments of a receiver or golf ball recording unit described above. At step 1510, the recorded hit golf ball data may be output to other systems, including those described below in reference to FIG. 17 (discussed below). In some cases, the hit golf ball data may be recorded for later output to other systems. In other cases, the hit golf ball data may be immediately output to other systems.

[0056] FIG. 16 illustrates an exemplary embodiment of a method 1600 of obtaining data by sensing an output from the piezoelectric material in a golf ball. The order of the steps illustrated in FIG. 16 is exemplary and not required. In a first step 1602, a detector senses the output from the piezoelectric material portion of a golf ball when hit by a golf club. As described above in reference to FIG. 11, the detector may include a magnetic field sensor for sensing a magnetic field associated with output from the piezoelectric material portion of the golf ball as it moves after being hit. At step 1604, the detector correlates the sensed output from the piezoelectric material portion to hit golf ball data. The detector may include circuitry as described above for performing the correlation.

[0057] Referring to FIG. 16, once the hit golf ball data has been correlated based on the sensed output from the piezoelectric material portion, the hit golf ball data may be recorded by a golf ball recording unit at step 1606. In some embodiments, the recording unit may be included with the detector. In other embodiments, the golf ball recording unit may be a separate unit in communication with the detector. The detector may be any one or more embodiments of a receiver or golf ball recording unit described above. At step 1608, the recorded hit golf ball data may be output to other systems, including those described below in reference to FIG. 17. In some cases, the hit golf ball data may be recorded for later output to other systems. In other cases, the hit golf ball data may be immediately output to other systems.

[0058] FIG. 17 is a schematic view 1700 of different embodiments for using hit golf ball data. Hit golf ball data 1702 may be obtained using one or more of the embodiments described above. Hit golf ball data 1702 may be sent to a computer 1704. In some embodiments, computer 1704 may include, but is not limited to: a desktop computer, a portable computer, a server, a smart phone or other portable device including a processor, a terminal connected to a server over a network, and other hardware or software configurations for processing data.

[0059] Referring to FIG. 17, computer 1704 may allow the obtained hit golf ball data to be used by different systems. In one embodiment, hit golf ball data 1702 may be used in connection with a golf ball fitting system 1708. Hit golf ball data obtained from a golf ball with piezoelectric material according to the present method and system may be used as a component in the system disclosed in copending and commonly owned U.S. Patent Application US 2011009215A1, entitled "Method and System for Golf Ball Fitting Analysis", and filed on July 7, 2009.

[0060] Referring to FIG. 17, in one embodiment, hit golf ball data 1702 may be used in connection with a golf club fitting system 1710. Hit golf ball data obtained from a golf ball with piezoelectric material according to the present method and system may be used as a component in any golf club fitting system that uses inputted data associated with a golf ball to determine a club selection.

[0061] In another embodiment, as shown in FIG. 17, hit golf ball data 1702 may be used in connection with a golfer profile database 1712. In some cases, golfer profile database 1712 may include historical data associated with a golfer. In other cases, golfer profile database 1712 may include hit golf ball data associated with a golfer's swing. In some embodiments, golfer profile database 1712 may store a golfer's inputs and information. This would enable a golfer to reevaluate after some time has lapsed to determine how their game has changed over time. This would also enable a golfer to prepare to play in a different location with different altitude and climate by changing only those inputs to their stored data. This would also enable portability of their information in case of travel or relocation.

[0062] Hit golf ball data obtained from a golf ball with piezoelectric material according to the present method and system may be part of a broader athlete data storage, analysis, and retrieval system in which vital statistics and game statistics are stored for review or analysis by various programs, and to recommend new equipment suited to an athlete's game. Such programs or data could be run on computer 1704, including hand held devices including a processor, such as smart phones or other personal computing devices, with the possibility of sharing the data by users who have given each other authorization to view the data. In some cases, Internet 1706 may be used to transmit the hit golf ball data 1702 to other computers or servers where the data may be stored, analyzed, and shared.

[0063] In addition to the embodiments described above, a golf ball with piezoelectric material may be used in other systems that make use of the properties of the piezoelectric material. For example, a system and method could apply a voltage to a golf ball with a piezoelectric material to generate a compressive force on the golf ball.

In such a system and method, the compressive force could be used to generate an additional push or bounce of the golf ball against a club face of a golf club or could be used to harden the cover of the golf ball before impact for spin reduction.

Claims

1. A golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) comprising:

   a cover (302, 322, 342, 362, 382, 1002);
   a core (306, 326, 352, 366, 390); and
   a piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304)
   characterized in that the piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) is disposed proximate an underside of the cover (302, 322, 342, 362, 382, 1002).

2. The golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to claim 1, wherein the golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) further comprises an internal sensor (328, 348, 368, 388, 1008, 1206, 1306) for detecting an output generated by the piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304).

3. The golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to claim 2, wherein the internal sensor (328, 348, 368, 388, 1008, 1206, 1306) includes a transmitter (402) and an antenna (400, 1208, 1308).

4. The golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to claims 2 or 3, wherein the internal sensor (328, 348, 368, 388, 1008, 1206, 1306) further includes a data storage device (404, 1310).

5. The golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to claims 2 or 3, wherein the internal sensor (328, 348, 368, 388, 1008, 1206, 1306) is disposed inside the core (306, 326, 352, 366, 390), the piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) is disposed between the core (306, 326, 352, 366, 390) and the cover (302, 322, 342, 362, 382, 1002), and a lead (330, 350, 370) connects the internal sensor (328, 348, 368, 388, 1008, 1206, 1306) to the piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304).

6. The golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to claims 1, 2, or 3, wherein the piezoelectric material layer (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) comprises polyvinylidene fluoride material.

7. A system for obtaining hit golf ball data (1702) comprising the golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) according to one of claims 2-6, the system comprising:

   a detector (1112) in communication with the internal sensor (328, 348, 368, 388, 1008, 1206, 1306) for receiving the output measured by the internal sensor (328, 348, 368, 388, 1008, 1206, 1306), wherein the detector (1112) uses the output to obtain hit golf ball data (1702).

8. The system according to claim 7, wherein the detector (1112) is a receiver (106) including an antenna (202, 1312) that receives a signal transmitted by the transmitter (402) within the golf ball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300).

9. The system according to claims 7 or 8, wherein the detector (1112) sends the hit golf ball data (1702) to at least a golf ball fitting system (1708), a golf club fitting system (1710), or a golfer profile database (1712).

Patentansprüche

1. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300), der umfasst:

   eine Umhüllung (302, 322, 342, 362, 382, 1002);
   einen Kern (306, 326, 352, 366, 390); und
   eine Schicht (304, 324, 344,_364,_384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material,
   dadurch gekennzeichnet, dass
   die Schicht (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material benachbart zu einer Unterseite der Umhüllung (302, 322, 342, 362, 382, 1002) angeordnet ist.

2. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach Anspruch 1, wobei der Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) des Weiteren einen internen Sensor (328, 348, 368, 388, 1008, 1206, 1306) zum Erfassen eines durch die Schicht (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material erzeugten Ausgangs umfasst.

3. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach Anspruch 2, wobei der interne Sensor (328, 348, 368, 388, 1008, 1206, 1306) einen Sender (402) und eine Antenne (400, 1208, 1308) enthält.

4. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach Anspruch 2 oder 3, wobei der interne Sensor (328, 348, 368, 388, 1008, 1206, 1306) des Weiteren eine Datenspeichervorrichtung (404, 1310) enthält.

5. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach Anspruch 2 oder 3, wobei der interne Sensor (328, 348, 368, 388, 1008, 1206, 1306) im Inneren des Kerns (306, 326, 352, 366, 390) angeordnet ist, die Schicht (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material zwischen dem Kern (306, 326, 352, 366, 390) und der Umhüllung (302, 322, 342, 362, 382, 1002) angeordnet ist und eine Zuleitung (330, 350, 370) den internen Sensor (328, 348, 368, 388, 1008, 1206, 1306) mit der Schicht (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material verbindet.

6. Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach Anspruch 1, 2 oder 3, wobei die Schicht (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) aus piezoelektrischem Material Polyvinylidenfluorid-Material umfasst.

7. System zum Gewinnen von Golfballabschlagsdaten (1702), das den Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) nach einem der Ansprüche 2-6 umfasst, wobei das System umfasst:

einen Detektor (1112), der mit dem internen Sensor (328, 348, 368, 388, 1008, 1206, 1306) in Kommunikationsverbindung steht, um den durch den internen Sensor (328, 348, 368, 388, 1008, 1206, 1306) gemessenen Ausgang zu empfangen, wobei der Detektor (1112) den Ausgang verwendet, um Golfballabschlagsdaten (1702) zu gewinnen.

8. System nach Anspruch 7, wobei der Detektor (1112) ein Empfänger (106) ist, der eine Antenne (202, 1312) enthält, die ein durch den Sender (402) in dem Golfball (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) gesendetes Signal empfängt.

9. System nach Anspruch 7 oder 8, wobei der Detektor (1112) die Golfballabschlagsdaten(1702) zu einem Golfball-Anpassungssystem (1708), einem Golfschläger-Anpassungssystem (1710) oder einer Golfspieler-Profildatenbank (1712) sendet.

Revendications

1. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) comprenant :

un recouvrement (302, 322, 342, 362, 382, 1002) ;
un coeur (306, 326, 352, 366, 390) ; et
une couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304)
caractérisée en ce que la couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) est disposée à proximité de la face inférieure du recouvrement (302, 322, 342, 362, 382, 1002).

2. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon la revendication 1, dans laquelle la balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) comprend en outre un capteur interne (328, 348, 368, 388, 1008, 1206, 1306) pour détecter la sortie générée par la couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304).

3. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon la revendication 2, dans laquelle le capteur interne (328, 348, 368, 388, 1008, 1206, 1306) comporte un émetteur (402) et une antenne (400, 1208, 1308).

4. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon les revendications 2 ou 3, dans laquelle le capteur interne (328, 348, 368, 388, 1008, 1206, 1306) comporte en outre un dispositif de mémorisation de données (404, 1310).

5. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon les revendications 2 ou 3, dans laquelle le capteur interne (328, 348, 368, 388,_ 1008, 1206, 1306) est disposé à l'intérieur du coeur (306, 326, 352, 366, 390), la couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) est disposée entre le coeur (306, 326, 352, 366, 390) et le recouvrement (302, 322, 342, 362, 382, 1002), et un conducteur (330, 350, 370) relie le capteur interne (328, 348, 368, 388, 1008, 1206, 1306) à la couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304).

6. Balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon les revendications 1, 2 ou 3, dans laquelle la couche de matériau piézo-électrique (304, 324, 344, 364, 384, 1004, 1104, 1204, 1304) comprend un matériau en fluorure de polyvinylidène.

7. Système pour obtenir des données de frappe d'une balle de golf (1702) comprenant la balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300) selon l'une des revendications 2 à 6, le système comprenant :

un détecteur (1112) en communication avec le capteur interne (328, 348, 368, 388, 1008, 1206, 1306) pour recevoir la sortie mesurée par le capteur interne (328, 348, 368, 388, 1008, 1206, 1306), dans lequel le détecteur (1112) utilise la sortie pour obtenir les données de frappe de la balle de golf (1702).

8. Système selon la revendication 7, dans lequel le détecteur (1112) est un récepteur (106) incluant une antenne (202, 1312) qui reçoit un signal transmis par l'émetteur (402) à l'intérieur de la balle de golf (300, 320, 340, 360, 380, 1000, 1100, 1200, 1300).

9. Système selon les revendications 7 ou 8, dans lequel le détecteur (1112) envoie les données de frappe de la balle de golf (1702) au moins à un système d'adaptation de balle de golf (1708), un système d'adaptation de club de golf (1710) ou une base de données de profils de golfeurs (1712).

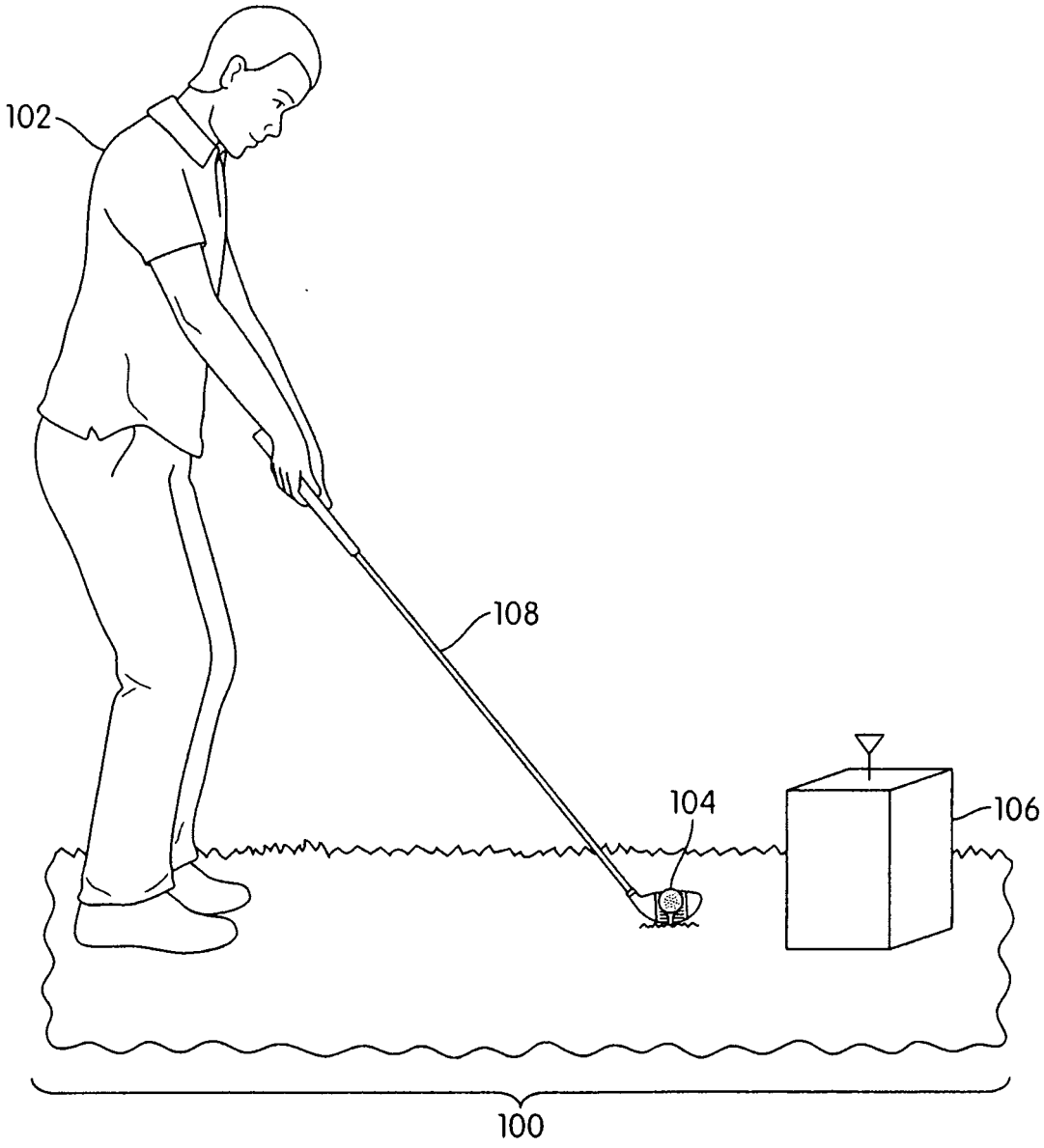

FIG. 1

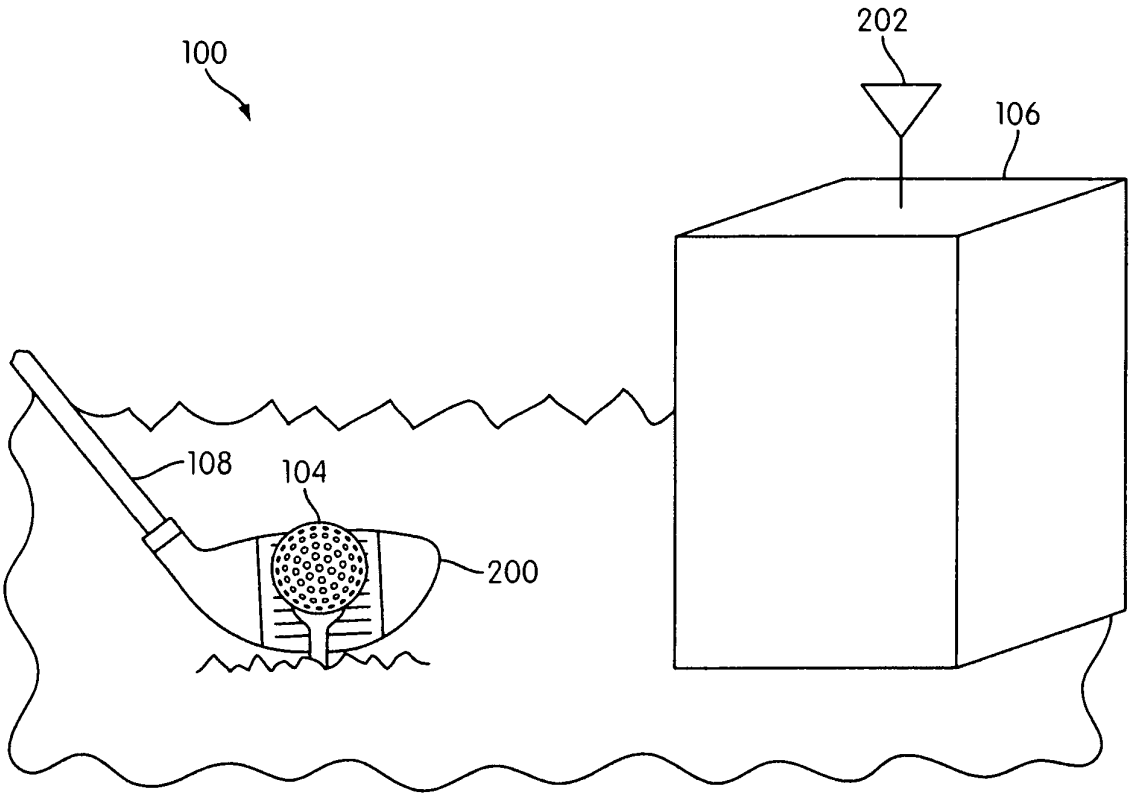

FIG. 2

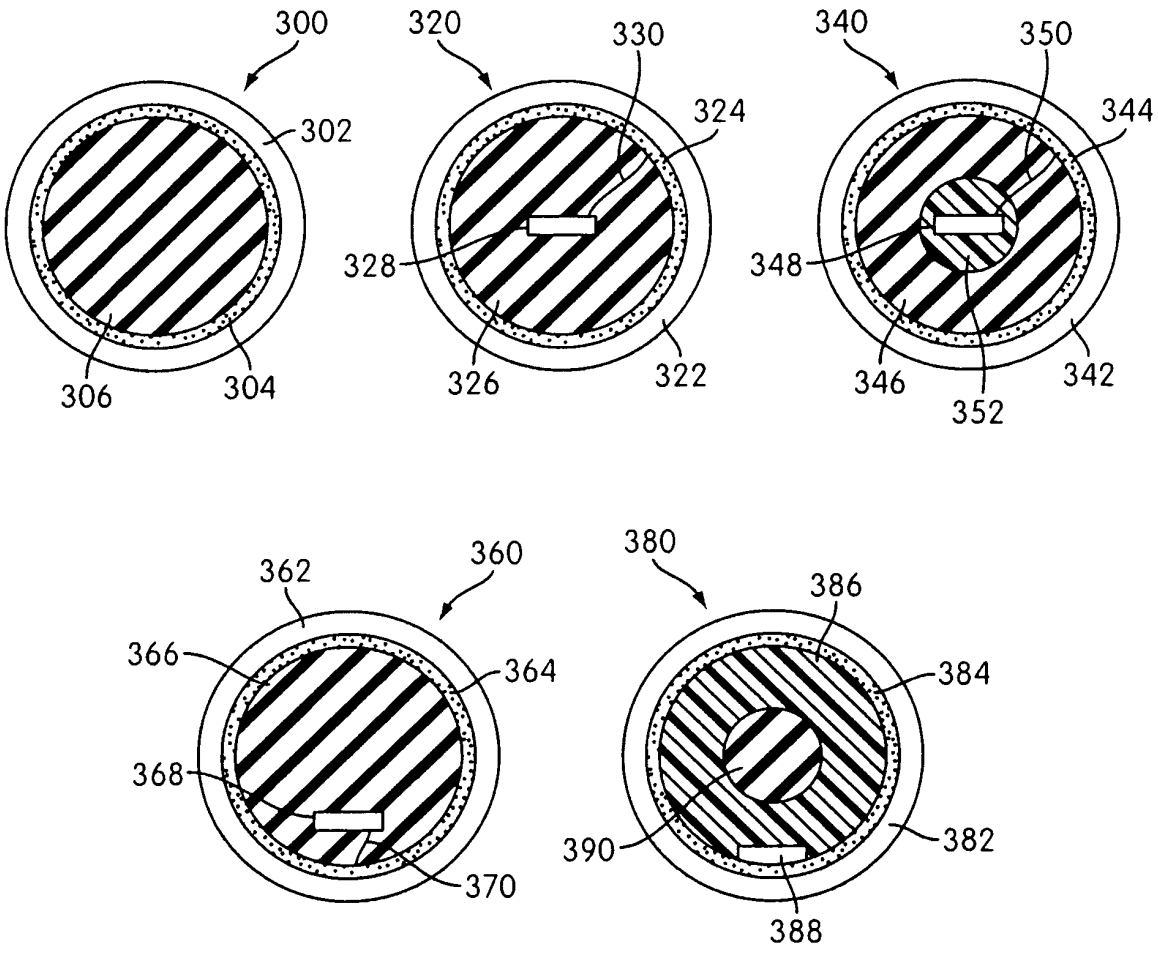
300
302
304
306
320
330
324
328
322
326
340
350
344
348
342
346
352
360
362
366
364
368
370
380
386
384
390
382
388

FIG. 3

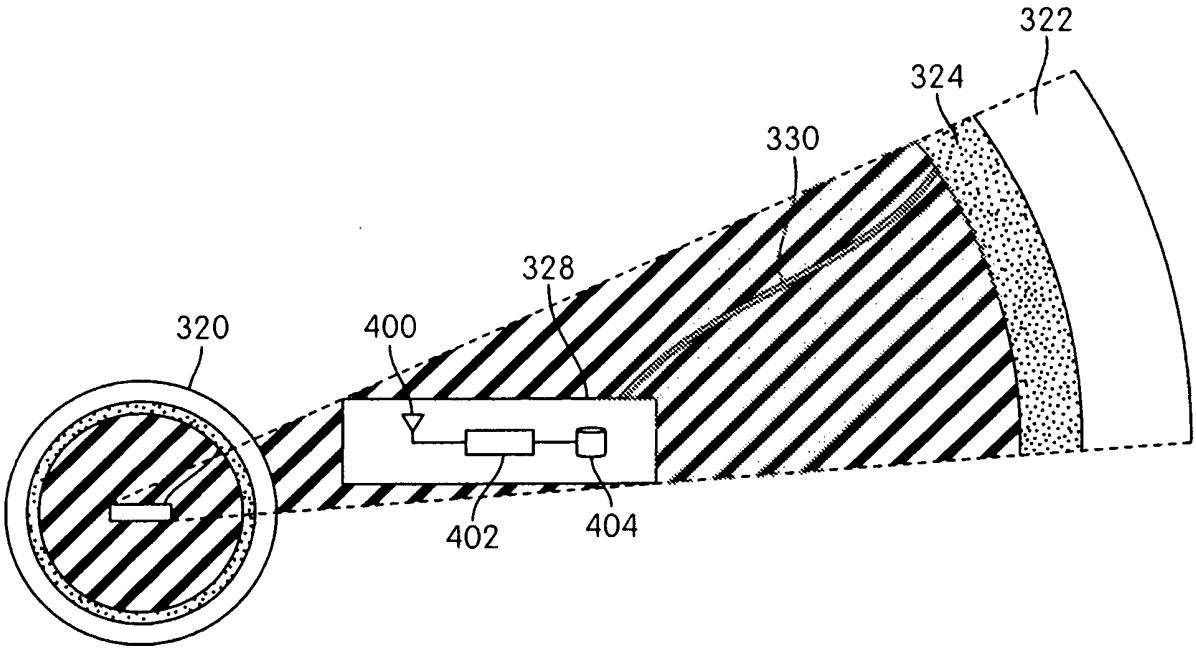

FIG. 4

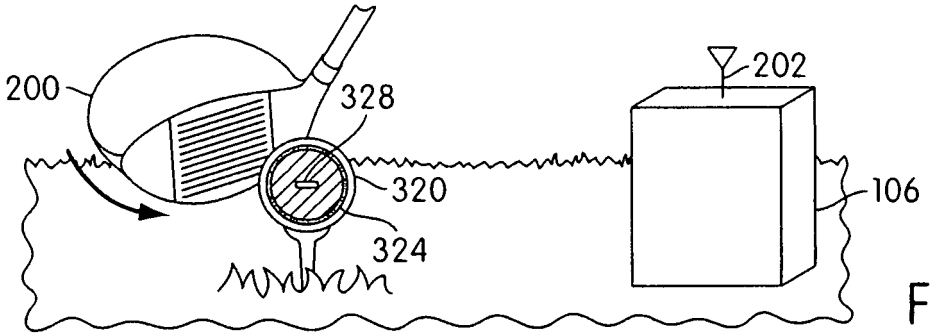

FIG. 5

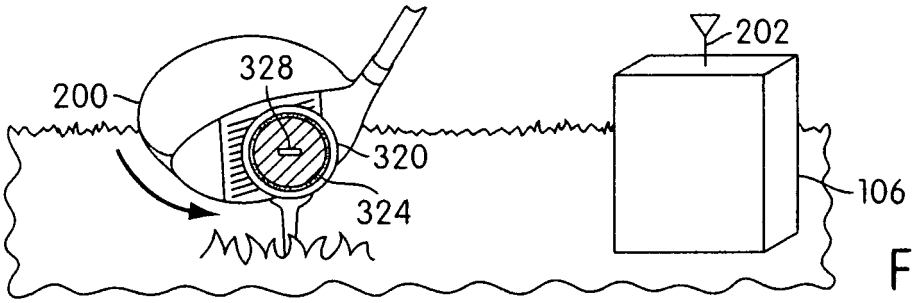

FIG. 6

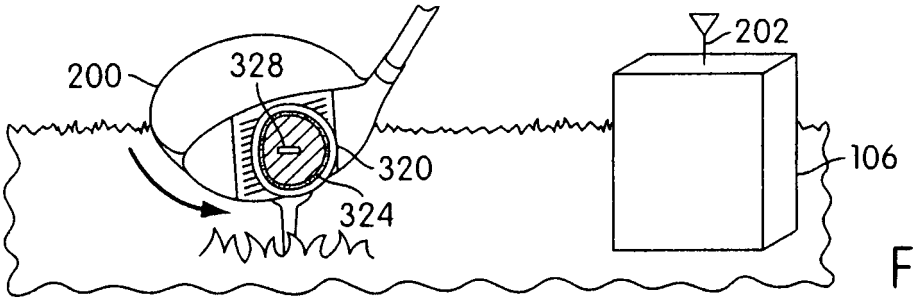

FIG. 7

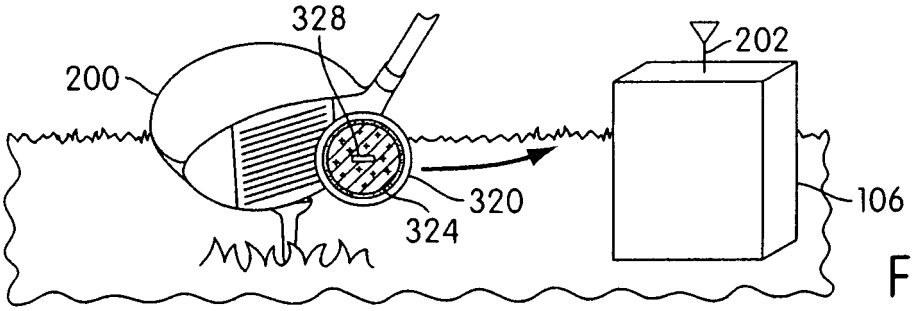

FIG. 8

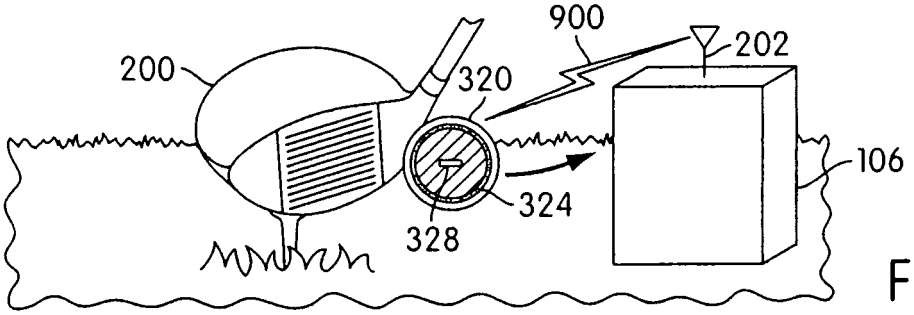

FIG. 9

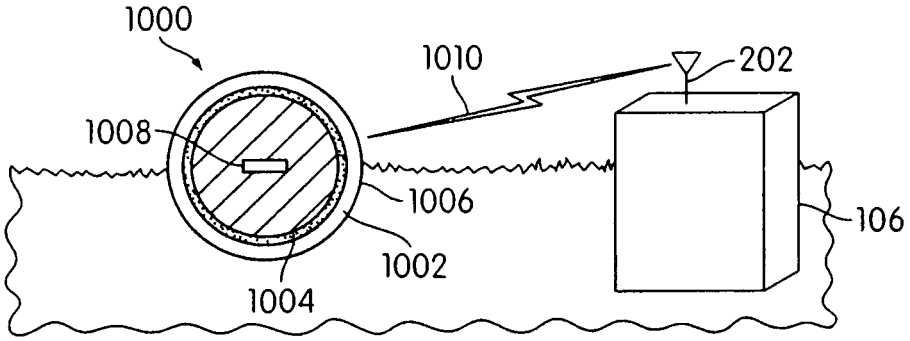

FIG. 10

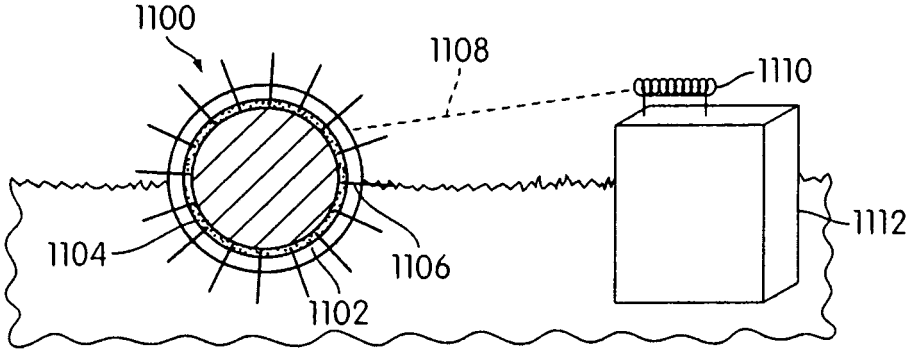

FIG. 11

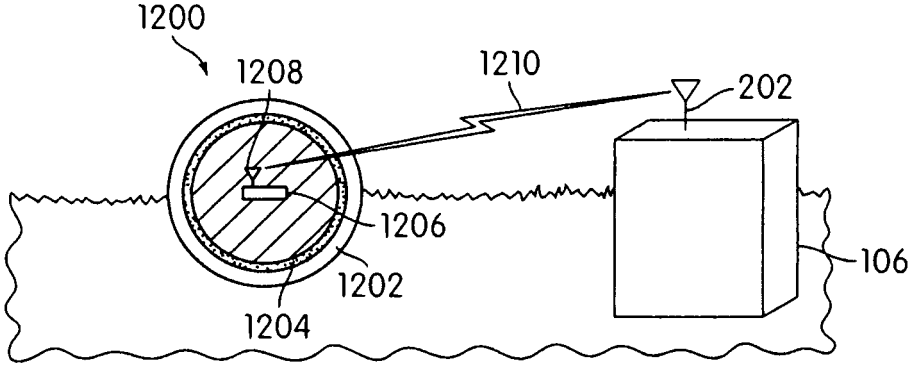

FIG. 12

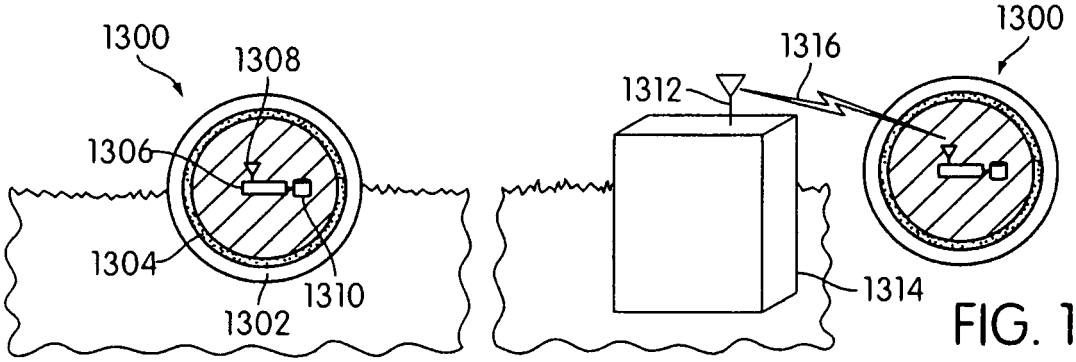

FIG. 13

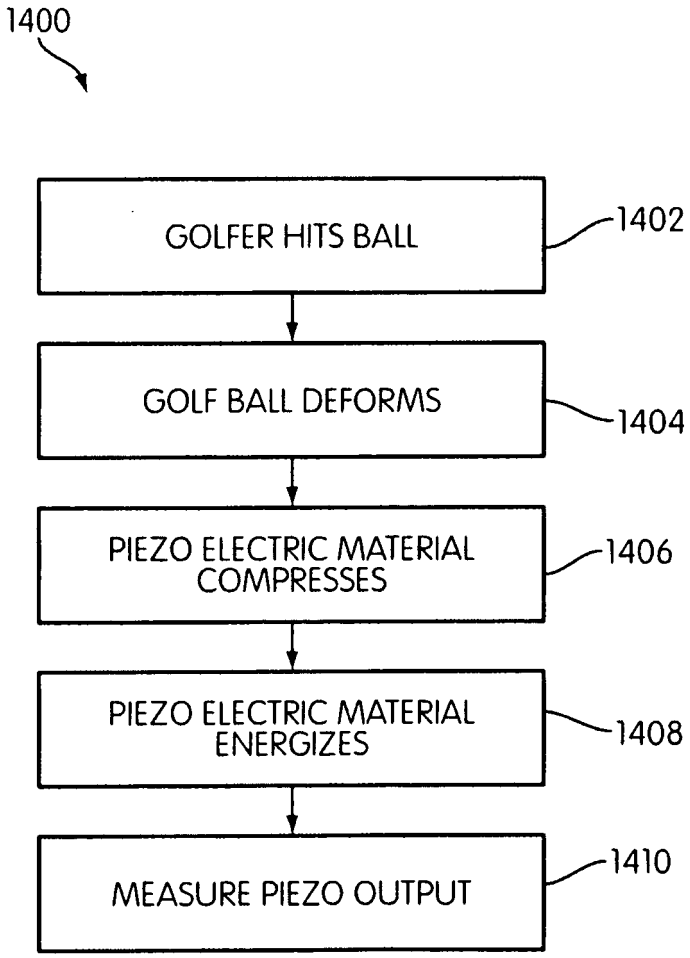
1400
GOLFER HITS BALL
1402
GOLF BALL DEFORMS
1404
PIEZO ELECTRIC MATERIAL COMPRESSES
1406
PIEZO ELECTRIC MATERIAL ENERGIZES
1408
MEASURE PIEZO OUTPUT
1410

FIG. 14

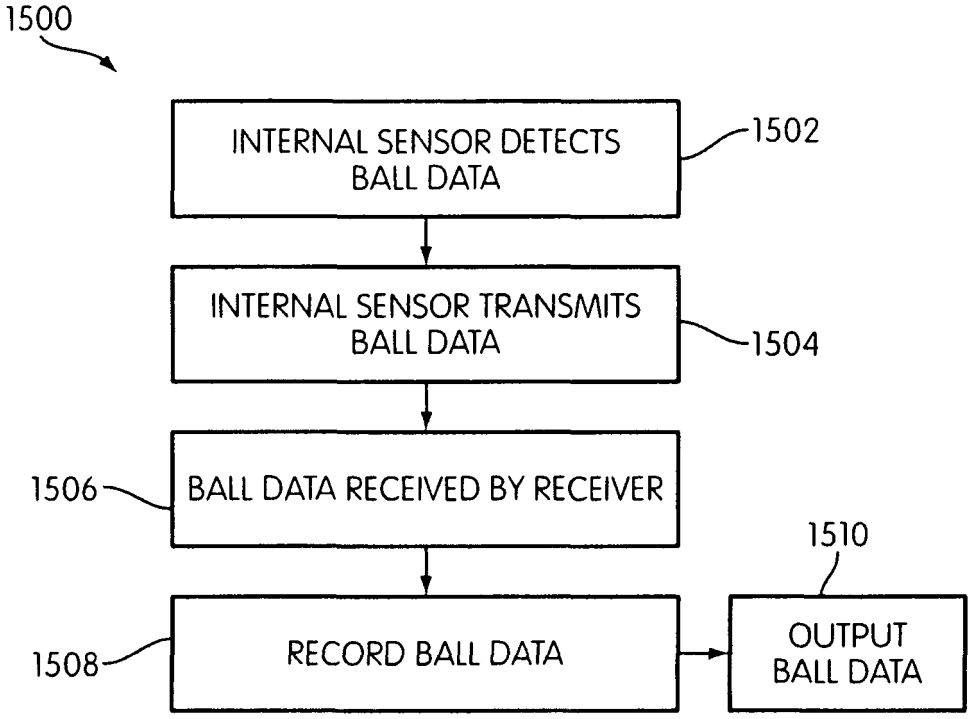
1500
INTERNAL SENSOR DETECTS BALL DATA
1502
INTERNAL SENSOR TRANSMITS BALL DATA
1504
1506
BALL DATA RECEIVED BY RECEIVER
1510
1508
RECORD BALL DATA
OUTPUT BALL DATA

FIG. 15

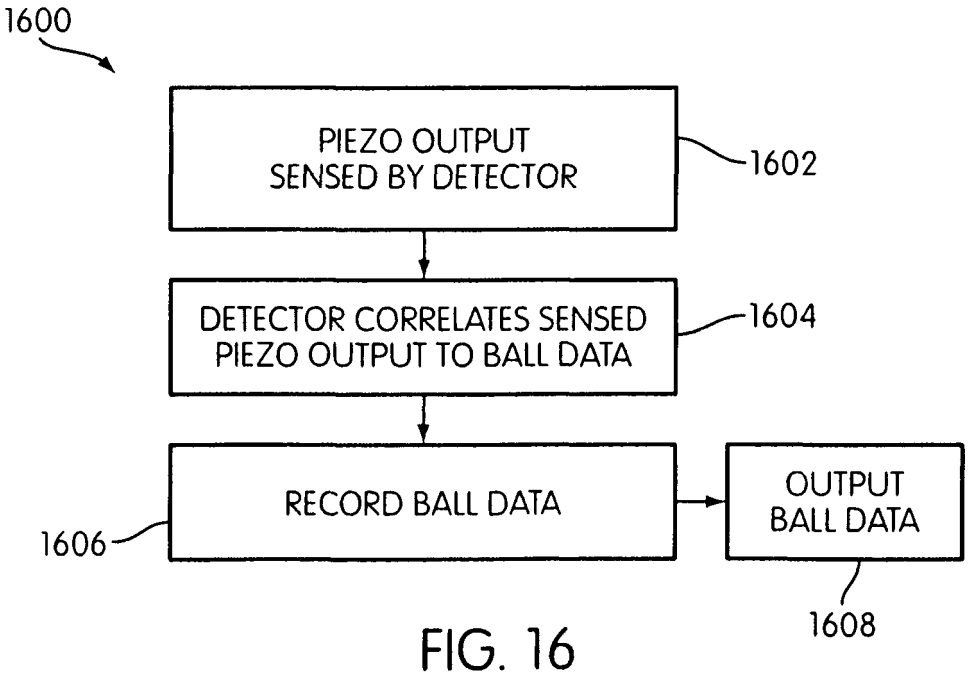
1600
PIEZO OUTPUT SENSED BY DETECTOR
1602
DETECTOR CORRELATES SENSED PIEZO OUTPUT TO BALL DATA
1604
RECORD BALL DATA
OUTPUT BALL DATA
1606
1608

FIG. 16

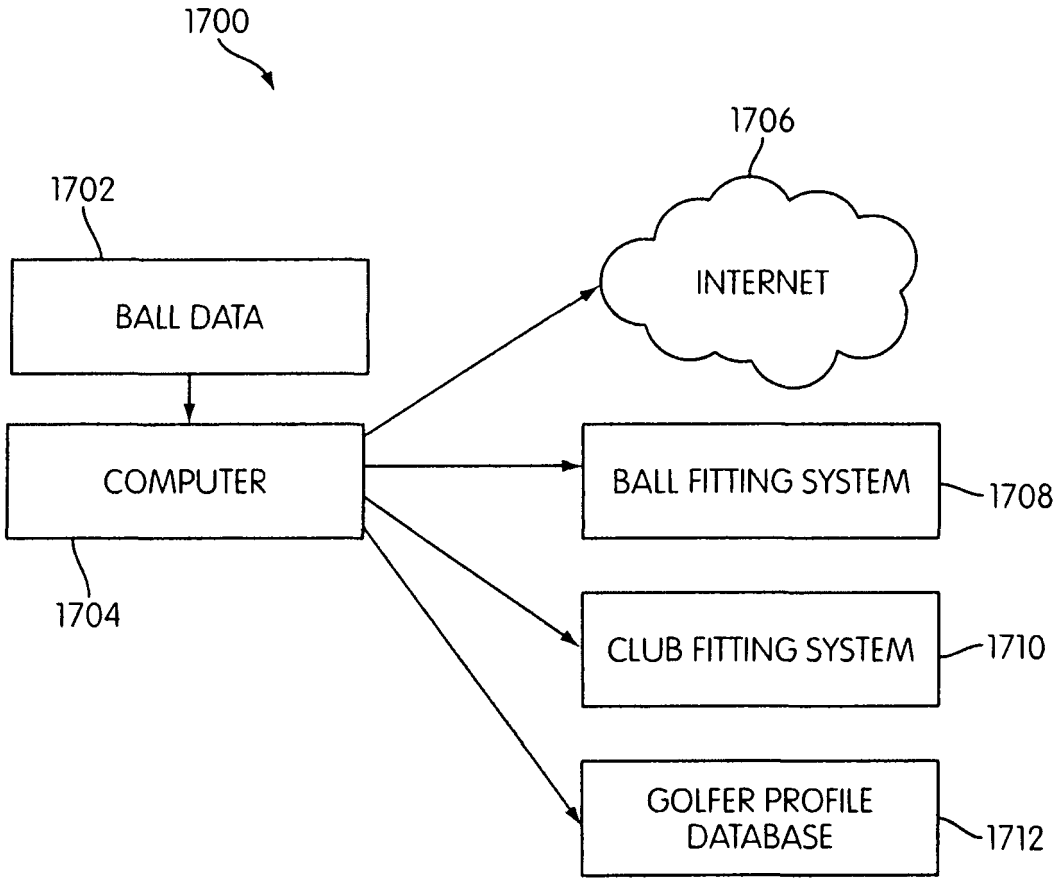
1700
1706
1702
INTERNET
BALL DATA
COMPUTER
BALL FITTING SYSTEM
1708
1704
CLUB FITTING SYSTEM
1710
GOLFER PROFILE DATABASE
1712

FIG. 17

REFERENCES CITED IN THE DESCRIPTION

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- US 2009003136 A1 **[0007]**
- US 2011009215 A1 **[0059]**