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(54) **SELF-RECORDING GOLF BALL, GOLF BALL CUP, AND READING DEVICE SYSTEM**

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(57) **ABSTRACT**

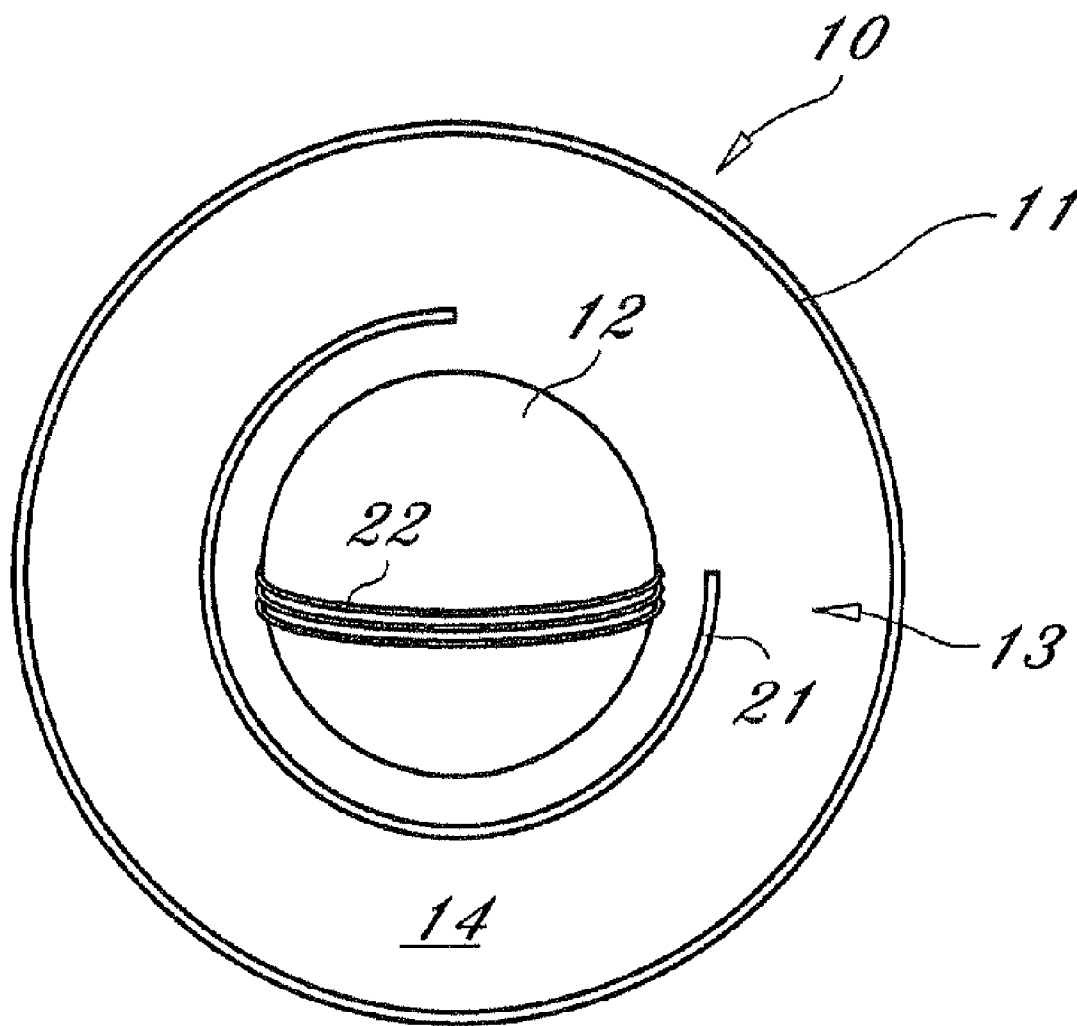
The present invention provides a self-recording golf ball having an inner core defined by an outer cover, said golf ball further comprising a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and housed within said inner core of said golf ball; wherein the microprocessor further is programmed to record data corresponding to strokes received by the ball and to transmit the data, via the receive and transmit device, to a second microprocessor.

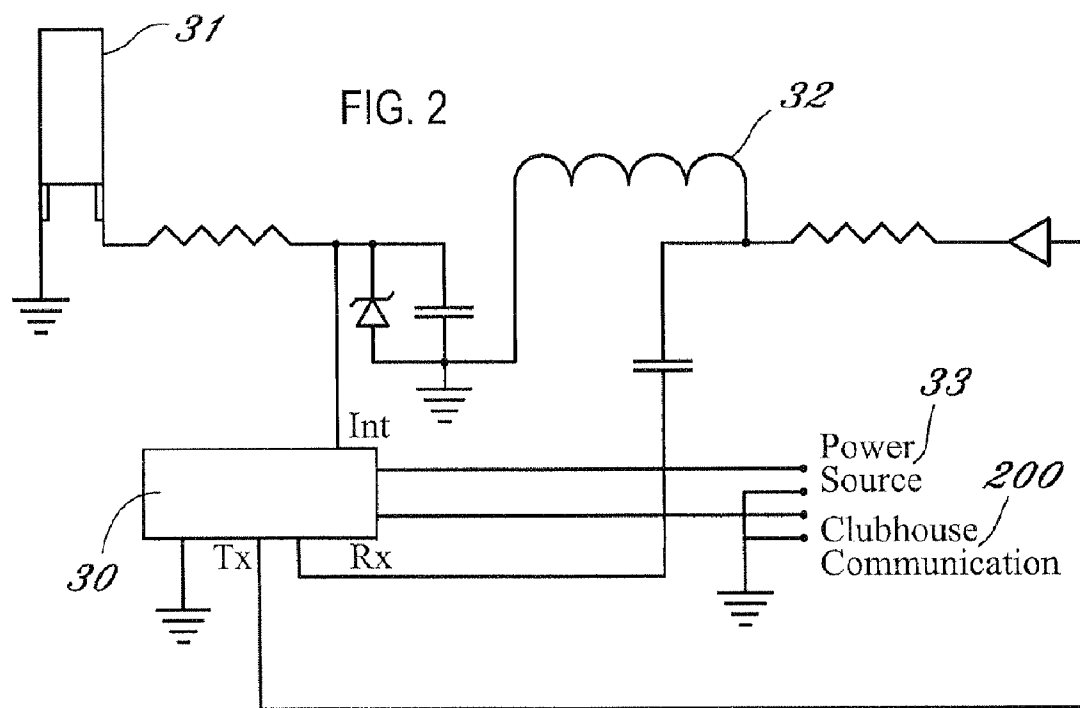
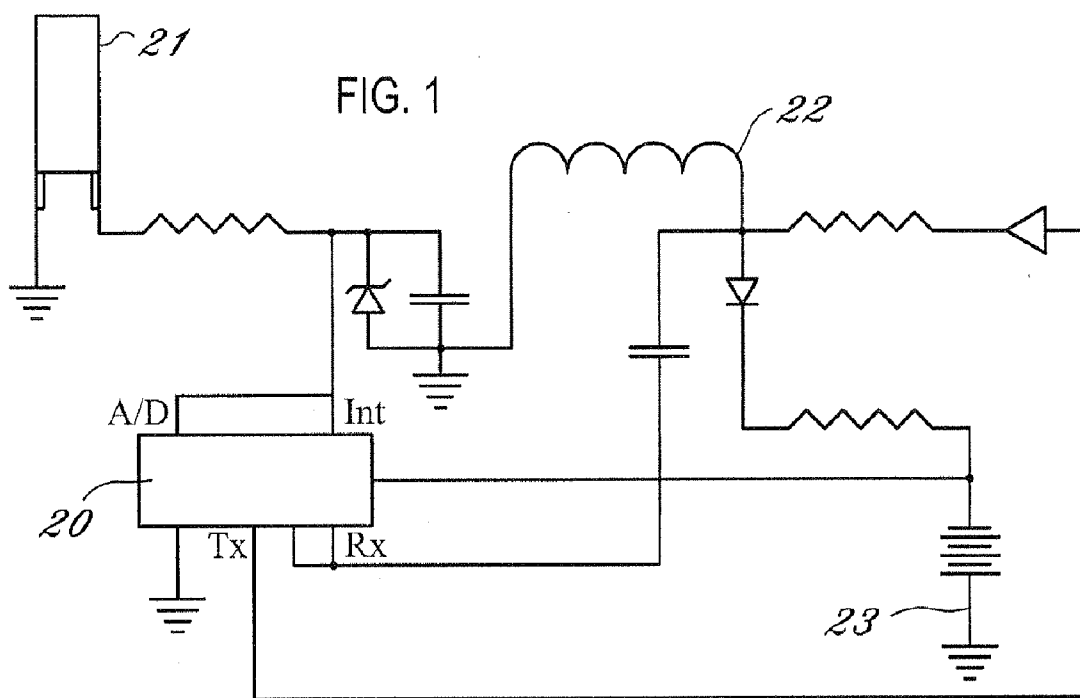
(21) **Appl. No.: 10/908,010**

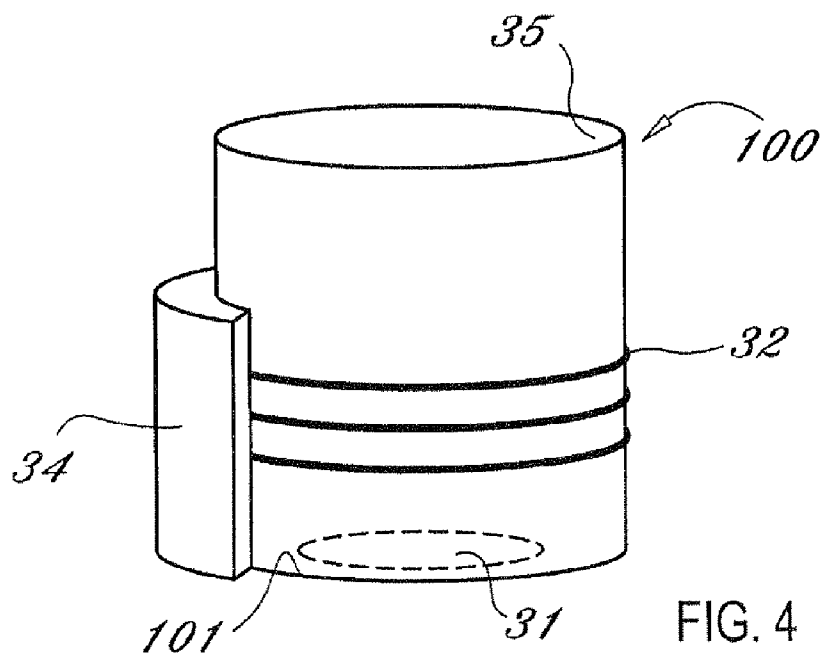
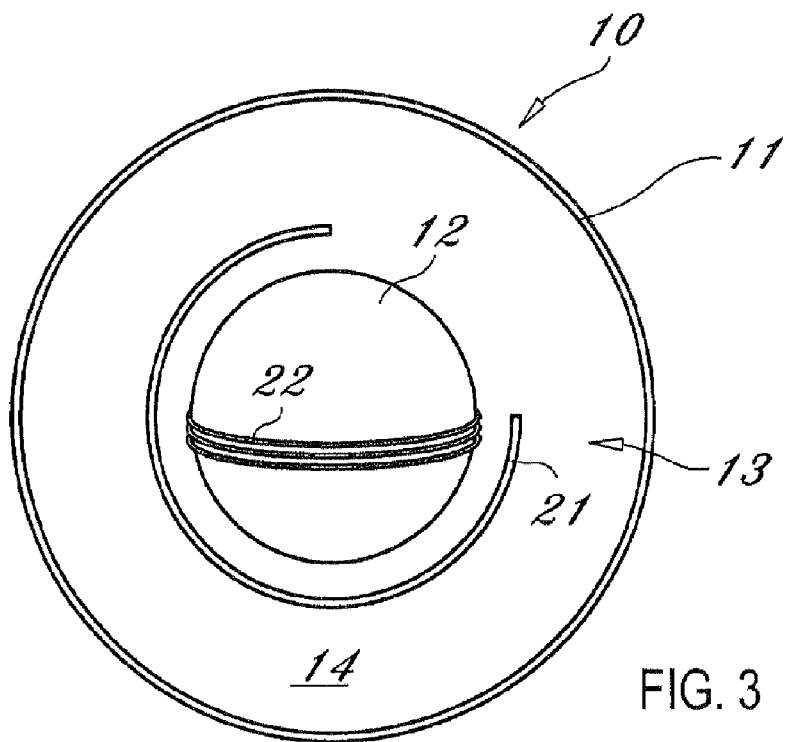
(22) **Filed: Apr. 25, 2005**

**Related U.S. Application Data**

(63) **Continuation of application No. 10/165,612, filed on Jun. 7, 2002, now Pat. No. 6,884,180.**







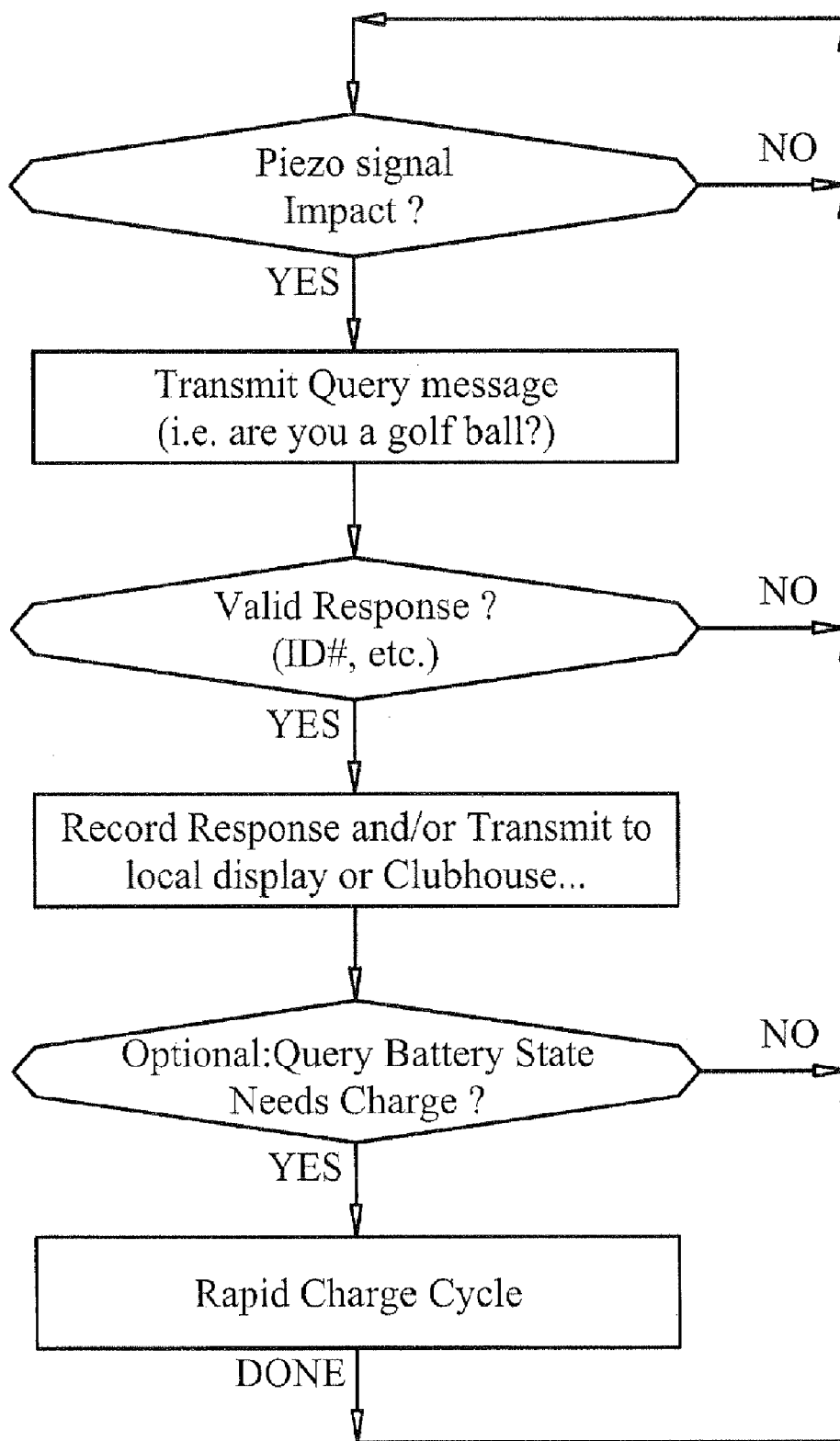
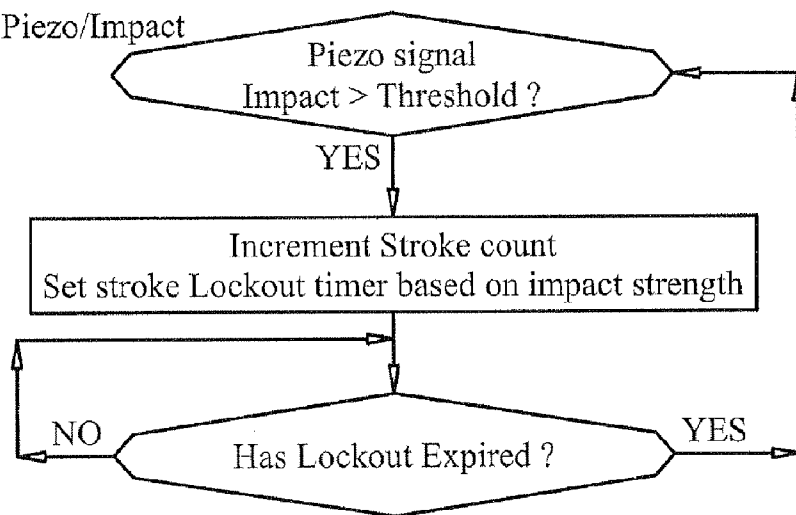


FIG. 5

Process 1.

Piezo/Impact



Process 2.

External Query

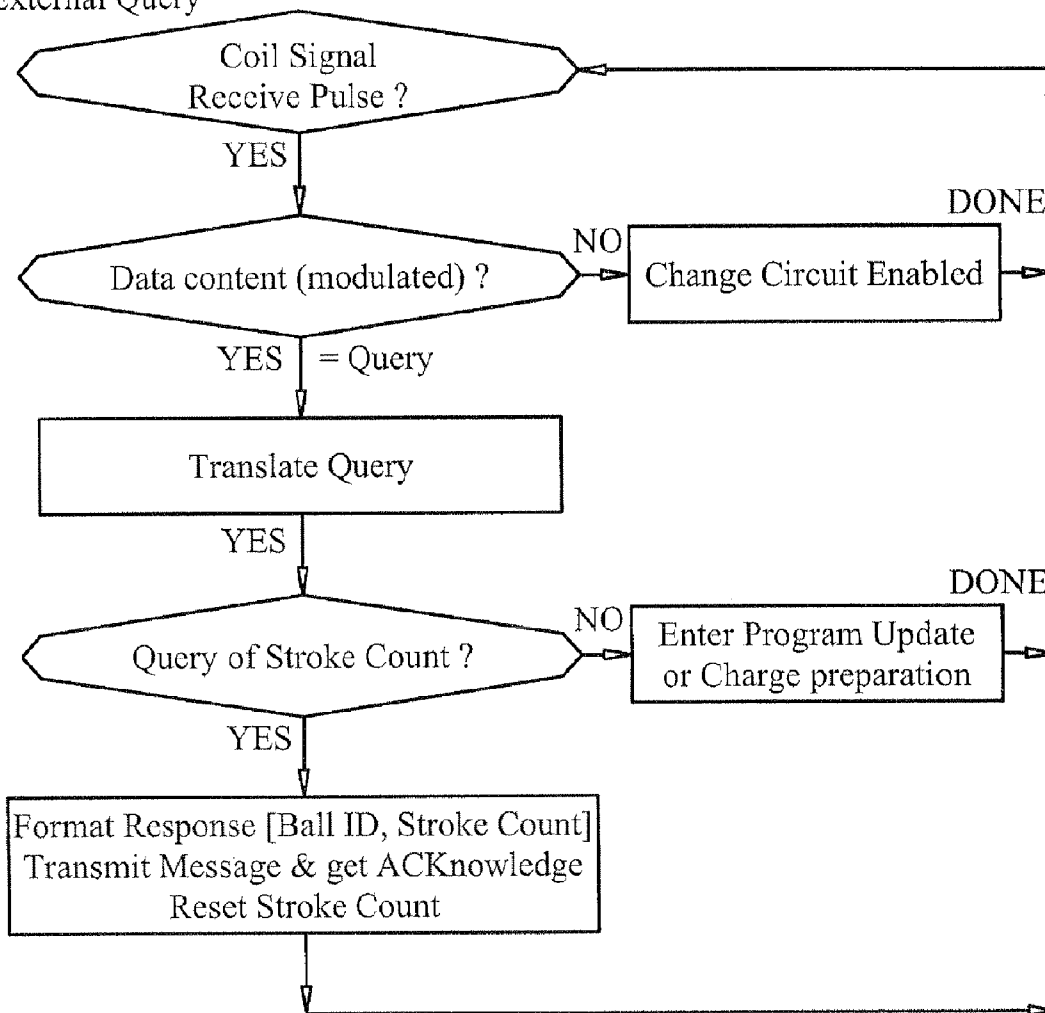


FIG. 6

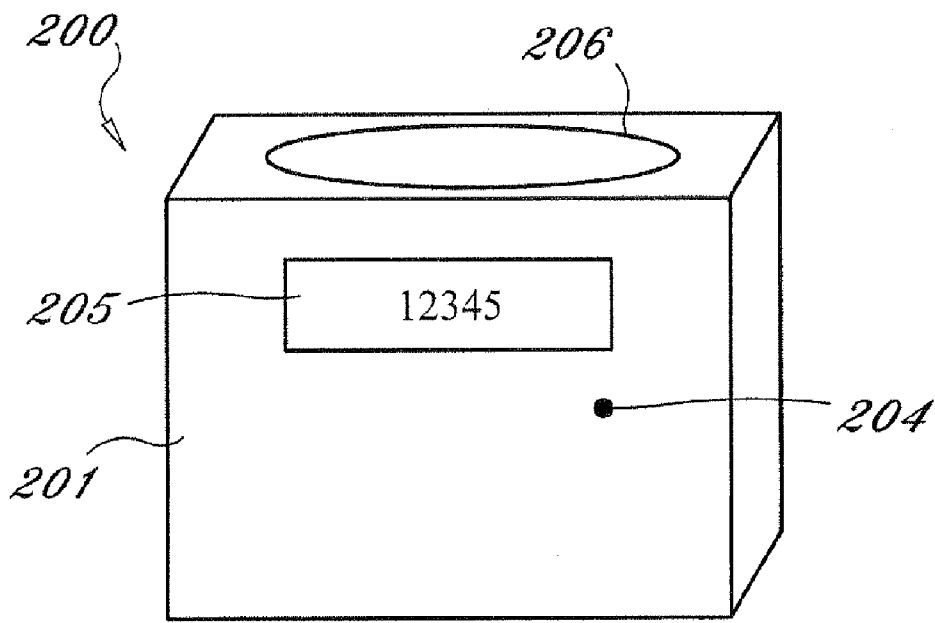


FIG. 7

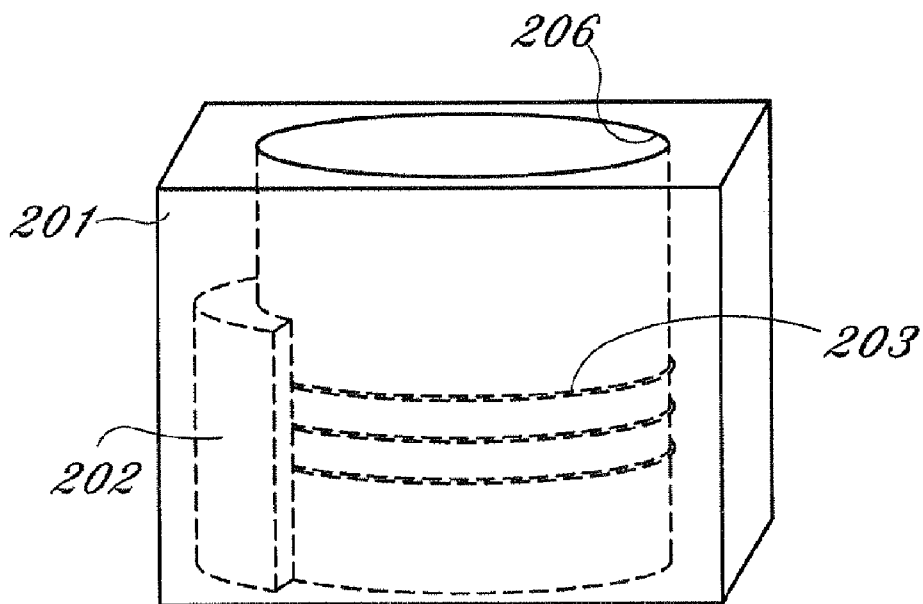


FIG. 8

## SELF-RECORDING GOLF BALL, GOLF BALL CUP, AND READING DEVICE SYSTEM

[0001] This application is a continuation of application Ser. No. 10/165,612, filed Jun. 7, 2002, herein incorporated by reference.

### TECHNICAL FIELD

[0002] The present invention is directed to golf balls, golf ball cups, and golf ball reading devices designed, in certain embodiments, to record the number of strokes received by a golf ball during play between successive rounds and/or verify original ball-in-play.

### SUMMARY OF THE INVENTION

[0003] The present invention provides a golf ball comprising an inner core surrounded by an outer cover; a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and housed within said inner core; wherein the microprocessor is pre-programmed with information identifying the golf ball, wherein the piezo sensor is operable to detect when the ball has been struck and to subsequently activate the microprocessor; wherein the microprocessor is pre-programmed to (i) record data corresponding to one stroke upon activation (ii) to record a magnitude of force of said one stroke, and (iii) to subsequently ignore signals transmitted by said piezo sensor after said one stroke is received by said ball for a period of time thereafter correlative to said magnitude of force of said one stroke; wherein the receive and transmit device is operable to receive an incoming signal and to transmit the identification of the ball and any recorded data in response the incoming signal.

[0004] The present invention may further provide a golf ball cup for receiving a golf ball, said cup comprising: a cup body; a means for sensing when a golf ball enters the cup body; a means for signaling the golf ball to transmit data; a means for receiving data transmitted from the golf ball; a means for storing data transmitted from the golf ball; and a means for transmitting the data to a remote computer; wherein the means for sensing when a golf ball enters the cup body, the means for signaling the golf ball to transmit data, the means for receiving data transmitted from the golf ball, the means for storing data transmitted from the golf ball; and the means for transmitting the data to a remote computer, are all electrically connected to each other and mounted on or within the cup body and powered by a power source.

[0005] In another embodiment, the present invention provides a golf ball scoring method comprising the steps of: providing a golf ball comprising an inner core surrounded by an outer cover, a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and housed within said inner core, wherein the microprocessor is pre-programmed with information identifying the golf ball; providing a golf ball cup for receiving the golf ball, said cup comprising a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and mounted on or within said cup; providing a central scoring computer remote from the golf ball cup; hitting the golf ball with a plurality of different golf clubs toward the cup; recording and storing data within the ball for each time the

ball is struck with one of the plurality of different golf clubs; hitting the ball into the cup with one of the plurality of different clubs such that the ball strikes the cup piezo sensor upon entering said cup, activating the cup microprocessor based on a signal from the cup piezo sensor that the ball has entered the cup, transmitting a signal from the cup and receiving the signal by the ball; transmitting the data from the ball and receiving the data by the cup; storing the data in the cup microprocessor; and transmitting the data from the cup microprocessor to the remote central scoring computer.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. 1 is an exemplary schematic of electrical circuitry of one embodiment of the inventive golf ball illustrated in FIG. 3.

[0007] FIG. 2 is an exemplary schematic of electrical circuitry of one embodiment of the inventive golf ball cup illustrated in FIG. 4.

[0008] FIG. 3 is a partial section view of one embodiment of the inventive golf ball.

[0009] FIG. 4 is a partial section view of one embodiment of the inventive golf ball cup.

[0010] FIG. 5 is a flow chart illustrating exemplary software processing of the golf ball cup's microprocessor.

[0011] FIG. 6 is a flow chart illustrating exemplary software processing of the golf ball's microprocessor.

[0012] FIG. 7 illustrates another embodiment of the invention comprising a reading device for the inventive golf ball.

[0013] FIG. 8 is an internal view of the embodiment illustrated in FIG. 7.

### DETAILED DESCRIPTION OF THE EMBODIMENTS

[0014] As shown in FIGS. 1 and 3, the present invention, in certain aspects, is directed to a golf ball 10 having an outer cover 11 that defines an inner core 13. The golf ball further includes a microprocessor 20, a power source 23, a receive and transmit (RT) device 22, a piezo sensor 21, and related circuitry (collectively referred to herein as "golf ball components"). These golf ball components are electrically connected to one another and housed within the inner core 13 of the ball. In one preferred embodiment, the microprocessor 20 and power source 23 are housed within a centrally disposed compartment 12 while the RT device 22 and piezo sensor 21 are disposed outside of the compartment 12 within the inner core 13, as shown, for example, in FIG. 3. The centrally disposed compartment may comprise a rigid shell or cast core. In one embodiment, the compartment may be a titanium (or similar metal or metal alloy) shell encasing the microprocessor and power source, for example, as well as a filler material, such as plastic, for example, to secure electronics housed therein. Alternatively, the electronics (i.e. microprocessor and power source) may be cast in a high impact plastic or acrylic material. Regardless of the construction of the inner compartment 12, FIG. 3 illustrates one exemplary arrangement of the RT device 22 and piezo sensor 21; however, it will be appreciated by one of ordinary

skill in the art that the RT device **22** and piezo sensor **21** may be arranged differently within the inner core **13**.

[0015] As known by those of ordinary skill in the art, there are several types golf ball constructions, as described, for example, in U.S. Pat. No. 6,379,269 to Nesbitt, et al. (incorporated herein by reference in its entirety), all of which have an outer cover surrounding some type of inner core. The outer cover **11** of the present invention may be fabricated and designed by any number of materials and methods known to the skilled artisan. Similarly, the inner core **13** of the inventive golf ball may be so fabricated and designed, provided the design is such as to provide for housing of the golf ball components described and illustrated herein. In one embodiment, the inner core **13** may comprise a high energy filling material **14** between the compartment **12** and outer cover **11**. Exemplary filling materials **14** include, but are not limited to, various cross-linked synthetic rubber compounds.

[0016] The inventive golf ball **10** is designed such that when the outer cover **11** of the ball is struck by an outside force, typically by a golfer's golf club, for example, the piezo sensor **21** generates a voltage to activate the microprocessor **20**. Preferably, the voltage generated is proportionate to the magnitude of the force generated by the golfer's stroke. An exemplary piezo sensor **21** is a polyvinylidene fluoride (PVDF)-based film sensor. It will be appreciated by the skilled artisan that other sensors capable of "sensing" or being responsive to vibrations generated upon impact include, but are not limited to, MEMS-based accelerometers, and the like. As illustrated in **FIG. 5**, the microprocessor **20** is programmed to record stroke data corresponding to the number of strokes received by the golf ball by a golfer. In one embodiment of the invention, the microprocessor **20** is programmed to operate in a low power "sleep" mode until the impact of the golf club on the ball. The force of impact upon the ball then activates the piezo sensor to generate a voltage to "wake up" the microprocessor **20**, which in turn, records the stroke. The microprocessor **20** is preferably further programmed to "lock out" recordation of any further impact forces acted upon the golf ball for a pre-determined period of time, thereby preventing recordations of false strokes upon the ball as the ball bounces while in play. That is, the microprocessor, in lock-out mode, will ignore signals transmitted by the piezo sensor corresponding to various impacts received by the ball after the golfer's stroke. The length of the lock-out is based upon the magnitude of the force of the stroke recorded, which is desirable to allow for both long drives and putts. After the lock-out period, the microprocessor returns to a low power "sleep" mode until the golfer's next stroke.

[0017] In other embodiments, the microprocessor may be further programmed to record various golf ball identification information, including, but not limited to, the golfer's name and golf ball identification number or code. Recordation of a unique golfer identification number or code is especially useful for "ball-in-play" verification, wherein the system will verify that the same ball is being played (and thus not substituted) during play.

[0018] Referring now to **FIGS. 5-6**, when the golf ball is played, the microprocessor **20** and RT device **22**, in combination, are designed to transmit information about the ball recorded therein to a system designed to receive and inter-

pret such information. This information includes, but is not limited to, golf ball identification (e.g. golfer's name, golf ball identification number or code, etc.), the magnitude of force of the strokes received upon the ball, and the number of strokes received by the ball for a given hole. The present invention, therefore, further includes a golf ball cup **100** designed to receive the ball. Preferably the cup **100** is designed for installation within an outdoor golf course hole, and most preferably, for optimal benefits, the inventive cup **100** may be installed in every hole of the golf course. However, other embodiments of inventive system include installation of the cup on artificial putting greens, recreational miniature golf courses (i.e. "putt-putt" golf), and artificial indoor putting holes.

[0019] As shown in **FIGS. 2 and 4**, the cup **100** includes a microprocessor **30**, a power source **33**, a receive and transmit (RT) device **32**, and a piezo sensor **31** (collectively referred to herein as the "cup components"). The cup components are electrically connected to one another and mounted on or within the cup **100**. **FIG. 4** illustrates one arrangement of these cup components wherein the microprocessor **30**, power source **33**, and related circuitry are disposed within a housing compartment **34** located adjacent the outside of the cup **100**. It will be appreciated by one of ordinary skill in the art, however, that alternative arrangements of the these cup components may be made without departing from the spirit of the invention. For example, preferably the piezo sensor **31** is secured to the floor **101** of the cup to ensure that it will be struck by the ball upon entry of the ball into the cup. Alternatively, one or more piezo sensors may be incorporated within, or secured to, the inner wall **35** of the cup **100** (not shown).

[0020] In operation, when the golf ball **10** lands inside the cup **100** and strikes the cup's piezo sensor **31**, the sensor **31** generates a voltage to activate the cup's microprocessor **30** to interrogate the ball's microprocessor **20** via the respective RT devices **22, 32** of the ball and cup. The cup's microprocessor **30** then attempts to communicate with the golf ball's microprocessor **20** by energizing the cup's RT devices **32** and generating a signal corresponding to two components: 1) a large field burst that wakes up the ball's microprocessor **20** and 2) a standard pulsed communication mode for transmitting data. In one embodiment, if a signal is not received by the cup's microprocessor **20** (i.e. indicating perhaps an inactive or a conventional non-intelligent golf ball) within a specific pre-programmed period of time, the cup's microprocessor **30** returns to a low power sleep mode. When the inventive ball **10**, however, lands in the inventive cup **100**, the ball's microprocessor **20** is "awakened," verifies the integrity of the message, and then preferably transmits to the cup **100** various recorded information contained therein, such as golf ball identification data, the number of strokes received by the ball for that hole, the intensity of the strokes, and the like. Preferably, once the exchange of information between the two microprocessors **20, 30** has been made, the ball's microprocessor **20** is programmed to "reset" the stroke count to zero for the next play (i.e. hole). The ball's microprocessor **20** then, preferably, reverts back into a low power "sleep" mode until activation again upon impact of the ball **10**.

[0021] The golf ball information retrieved by the cup's microprocessor **30** may then be forwarded, via the cup's microprocessor **30** and RT device **32**, to a remote computer



**200** for display or storage therein. The remote computer may be in a club house and/or remotely connected to a score terminal for display of some or all of the data transmitted.

[**0022**] The cup components and related circuitry may be powered by a power source **33** comprising a battery, low voltage wiring, or standard AC current. In the case of battery power, a charging probe, such as an RF (radio frequency) probe, may be inserted into the cup for a short period of time, perhaps during routine course maintenance to provide the appropriate charging field for the cup's power source. The cup's power source, in turn, is designed to charge the ball's power source.

[**0023**] In other embodiments of the present invention, the ball's microprocessor **20** may be reprogrammed via the cup's microprocessor **30** and RT device circuitry **32**. The reprogramming may comprise changing the various ball information stored therein (e.g. identification number or code, golfer information, etc.) or the actual software affecting the microprocessor's actions. During this reprogramming process, the signal received by the ball from the cup's microprocessor is a sequence of data which the ball's microprocessor's kernel directs into flash memory. As with the communication of strokes in play, there is a two-way communication exchanged via the two RT devices for verification of each byte of data received by the ball's microprocessor **20**.

[**0024**] **FIGS. 7 and 8** illustrate another aspect of the present invention that may be used in lieu of, or in combination with, the inventive golf cup **100**. Specifically in this embodiment, the present invention includes a golf ball reading device **200** that may be of any number of configurations, one of which is illustrated in **FIG. 7**, wherein the main components are contained within a housing unit **201**. The reading device **200** includes a microprocessor, a power source, and related circuitry, all of which are not specifically shown in **FIGS. 7-8**, but indicated generally as being housed within a compartment **202**. The reading device **200** further includes a receive and transmit (RT) **203** device similar to or identical to the respective components described above for the golf cup **100**. In addition, the reading device may employ a switching device **204** to activate the reading device. The reading device may also include a display **205**, such as an LCD display, for example, for displaying the information read. Alternatively, the microprocessor could be programmed to activate an auditory device (not shown), which in turn, transmits an auditory alert or a specific auditory alert to confirm that the original ball is in play (or is not in play). The primary function of the inventive golf ball reading device **200**, therefore, would be to verify that the same golf ball is in play, and thus has not been switched during play. The golf ball, and more preferably the inventive golf ball **10** described herein, would therefore be placed near the reading device, or more preferably as shown in **FIGS. 7-8**, within a receptacle **206** contained within the device. Upon activation of the reading device, the device would read and verify the unique identification number or code, for example, of the golf ball in play via the respective microprocessors and RT devices of the golf ball and reading device **200**. This operation would be performed identically as described above for the inventive golf cup and golf ball. The microprocessor and RT device of the inventive reading device **200** may also be designed to reprogram the inventive golf ball **10** as described above for the inventive golf cup **100**.

[**0025**] For both the inventive golf ball, golf cup, and reading device described herein, conventional microprocessors known by those of ordinary skill in the art may be employed, such as, for example, MicroChip's PIC series of embedded processors. The RT devices for both the cup, ball, and reading device are preferably radio frequency (RF) coils; however, other types of non-contact communication devices may be employed, including, but not limited to, ultrasonic, audio, vibratory, and optical devices.

What is claimed is:

1. A golf ball comprising:

an inner core surrounded by an outer cover;

a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and housed within said inner core;

wherein the microprocessor is pre-programmed with information identifying the golf ball,

wherein the piezo sensor is operable to detect when the ball has been struck and to subsequently activate the microprocessor;

wherein the microprocessor is pre-programmed to (i) record data corresponding to one stroke upon activation (ii) to record a magnitude of force of said one stroke, and (iii) to subsequently ignore signals transmitted by said piezo sensor after said one stroke is received by said ball for a period of time thereafter correlative to said magnitude of force of said one stroke;

wherein the receive and transmit device is operable to receive an incoming signal and to transmit the identification of the ball and any recorded data in response to the incoming signal.

2. The ball of claim 1, wherein the microprocessor is programmed to remain in a low power sleep mode prior to activation by the piezo sensor.

3. The ball of claim 1, wherein the receive and transmit device is selected from radio frequency coils, ultrasonic devices, audio devices, vibratory devices, and optical devices.

4. The ball of claim 1, wherein the power source is rechargeable.

5. The ball of claim 1, wherein the microprocessor is further programmed such that upon transmission of data, the data correlating to the number and magnitude of force of the strokes received by the ball is erased.

6. The ball of claim 1, wherein the inner core further comprises a centrally disposed compartment, wherein said microprocessor and power source of said golf ball are housed within said compartment and said piezo sensor and device of said golf ball are disposed between said compartment and said outer cover.

7. A golf ball cup for receiving a golf ball, said cup comprising:

a cup body;

a means for sensing when a golf ball enters the cup body;

a means for signaling the golf ball to transmit data;

a means for receiving data transmitted from the golf ball;

a means for storing data transmitted from the golf ball; and

a means for transmitting the data to a remote computer; wherein the means for sensing when a golf ball enters the cup body, the means for signaling the golf ball to transmit data, the means for receiving data transmitted from the golf ball, the means for storing data transmitted from the golf ball; and the means for transmitting the data to a remote computer, are all electrically connected to each other and mounted on or within the cup body and powered by a power source.

8. The cup of claim 7, wherein the means for signaling the golf ball to transmit data, the means for receiving data transmitted from the golf ball, and the means for transmitting the data to a remote computer, are all provided by a receive and transmit device.

9. The cup of claim 7, wherein the means for sensing when a golf ball enters the cup body is provided by a piezo sensor.

10. The cup of claim 7, wherein the means for storing data transmitted from the golf ball is provided by a microprocessor.

11. The cup of claim 10, wherein the microprocessor is programmed to remain in a low power sleep mode prior to activation by the piezo sensor.

12. The cup of claim 8, wherein the receive and transmit device is selected from radio frequency coils, ultrasonic devices, audio devices, vibratory devices, and optical devices.

13. The cup of claim 7, wherein the power source is rechargeable.

14. The cup of claim 7, wherein the microprocessor is further programmed such that upon transmission of data to a remote computer, the data is erased from the microprocessor.

15. The cup of claim 7, wherein the data is selected from data corresponding to a number of strokes received by the ball and a magnitude of each stroke received by the ball.

16. A golf ball scoring method comprising the steps of: providing a golf ball comprising an inner core surrounded by an outer cover, a microprocessor, a power source, a receive and transmit device, and a piezo sensor elec-

trically connected to one another and housed within said inner core, wherein the microprocessor is pre-programmed with information identifying the golf ball;

providing a golf ball cup for receiving the golf ball, said cup comprising a microprocessor, a power source, a receive and transmit device, and a piezo sensor electrically connected to one another and mounted on or within said cup;

providing a central scoring computer remote from the golf ball cup;

hitting the golf ball with a plurality of different golf clubs toward the cup;

recording and storing data within the ball for each time the ball is struck with one of the plurality of different golf clubs;

hitting the ball into the cup with one of the plurality of different clubs such that the ball strikes the cup piezo sensor upon entering said cup,

activating the cup microprocessor based on a signal from the cup piezo sensor that the ball has entered the cup,

transmitting a signal from the cup and receiving the signal by the ball;

transmitting the data from the ball and receiving the data by the cup;

storing the data in the cup microprocessor; and

transmitting the data from the cup microprocessor to the remote central scoring computer.

17. The method of claim 16, further comprising the step of:

ignoring signals transmitted by said ball piezo sensor after said ball is hit with one of the plurality of clubs for a period of time correlative to a magnitude of force of the hit.

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