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[Continued on next page]

(54) Title: SYSTEMS AND METHODS FOR FITTING GOLF CLUB HEAD WEIGHT

(57) Abstract: Embodiments of systems and methods for fitting golf club head weight are generally described herein. In some embodiments, a system to analyze tempo data comprises a tempo analysis module configured to run on one or more processors, and is further configured to receive swing data from a tempo sensor. In many embodiments, the swing data comprises a backswing time and a downswing time. The system is further configured to generate a tempo ratio comprising the backswing time over the downswing time. In many embodiments, the system comprises a golf club head weight analysis module configured to run on the one or more processors. The golf club head weight analysis can be further configured to generate a recommended golf club head weight determined by at least the tempo ratio.

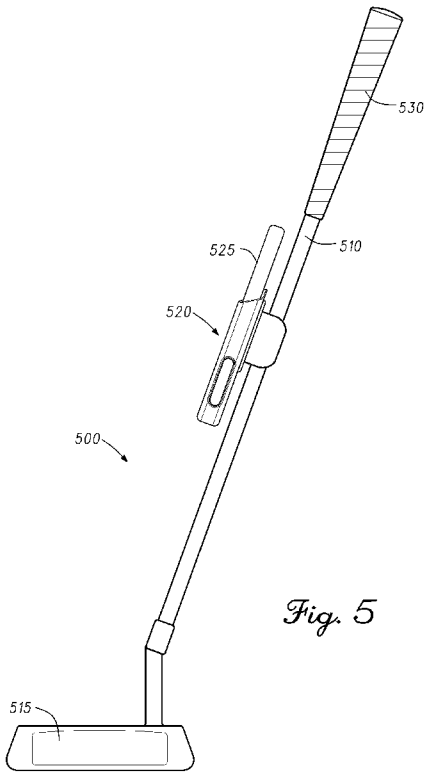


Fig. 5

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SYSTEMS AND METHODS FOR FITTING GOLF CLUB HEAD WEIGHT

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This claims priority to U.S. Patent Application No. 14/555,011, filed November 26, 2014, which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] This disclosure relates generally to golf clubs, and relates more particularly to fitting golf clubs comprising systems and methods for fitting golf club head weight.

BACKGROUND

[0003] Although conceptually simple, golf is a game that requires much practice to develop a player's skill in terms of mental and muscle coordination for repeatability and consistency of shots. Proper golf equipment can be helpful for consistent performance, and determining what golf equipment is suitable for an individual often involves trial and error that can be costly and time consuming. To ensure an individual is playing with appropriate equipment, the individual may be custom fitted for golf equipment via an individualized fitting process. Such fitting process may require measuring several characteristic features or dimensions of the individual, and determining proper equipment therefrom. Determining such characteristic features or dimensions in a repeatable and

precise manner can often be difficult, especially where several fitters are involved. Considering the above, further developments can be made to positively impact golf fitting systems and related methods.

BRIEF DESCRIPTION OF THE DRAWINGS

[0004] FIG. 1 illustrates a system to analyze tempo data, according to an embodiment;

[0005] FIG. 2 illustrates a flow diagram representation of recommending a golf club head weight, according to the system of FIG. 1;

[0006] FIG. 3 illustrates a flow diagram representation of recommending a golf club head weight, according to another embodiment of the system of FIG. 1;

[0007] FIG. 4 illustrates a method of recommending a golf club head weight, according to an embodiment;

[0008] FIG. 5 illustrates a system to analyze tempo data, according to an embodiment;

[0009] FIG. 6 illustrates a front elevational view of a computer system that is suitable for implementing an embodiment of the system disclosed in FIG. 1; and

[0010] FIG. 7 illustrates a representative block diagram of an example of the elements included in the circuit boards inside a chassis of the computer system of FIG. 6.

[0011] For simplicity and clarity of illustration, the drawing figures illustrate the general manner of construction, and descriptions and details of well-known features and techniques may be omitted to avoid unnecessarily obscuring the golf clubs and their methods of manufacture. Additionally, elements in the drawing figures are not necessarily drawn to scale. For example, the dimensions of some of the elements in the figures may be exaggerated relative to other elements to help improve understanding of

embodiments of the golf clubs and their methods of manufacture. The same reference numerals in different figures denote the same elements.

[0012] The terms "first," "second," "third," "fourth," and the like in the description and in the claims, if any, are used for distinguishing between similar elements and not necessarily for describing a particular sequential or chronological order. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments of golf clubs and methods of manufacture described herein are, for example, capable of operation in sequences other than those illustrated or otherwise described herein. Furthermore, the terms "contain," "include," and "have," and any variations thereof, are intended to cover a non-exclusive inclusion, such that a process, method, article, or apparatus that comprises a list of elements is not necessarily limited to those elements, but may include other elements not expressly listed or inherent to such process, method, article, or apparatus.

[0013] The terms "left," "right," "front," "back," "top," "bottom," "side," "under," "over," and the like in the description and in the claims, if any, are used for descriptive purposes and not necessarily for describing permanent relative positions. It is to be understood that the terms so used are interchangeable under appropriate circumstances such that the embodiments of golf clubs and methods of manufacture described herein are, for example, capable of operation in other orientations than those illustrated or otherwise described herein. The term "coupled," as used herein, is defined as directly or indirectly connected in a physical, mechanical, or other manner.

DESCRIPTION OF EXAMPLES OF EMBODIMENTS

[0014] Various embodiments of the systems and methods for fitting a golf club head weight include a system to analyze tempo data. In some embodiments, the system to analyze tempo data comprises a tempo analysis module configured to run on one or more processors. The tempo analysis module is further configured to receive swing data from a tempo sensor, the swing data comprising a backswing time and a downswing time, and generate a tempo ratio comprising the backswing time over the downswing time. The system to analyze tempo data further comprises a golf club head weight analysis module configured to run on the one or more processors, and further configured to generate a recommended golf club head weight determined by at least the tempo ratio.

[0015] Other embodiments of the systems and methods fitting a golf club head weight include a method to determine a recommended golf club head weight. The method to determine a recommended golf club head weight comprises executing a tempo analysis module on one or more processors to receive swing data from a swing sensor, the swing data comprises a backswing time and a downswing time, and generate a tempo ratio comprising the backswing time over the downswing time. The method to determine a recommended golf club head weight further comprises executing a golf club head weight analysis module on the one or more processors to receive the tempo ratio from the tempo analysis module and generate a recommended golf club head weight determined by at least the tempo ratio. The method further comprises executing a display module on the one or more processors to receive the recommended golf club head weight from the golf club head weight analysis module and display the recommended golf club head weight to a user.

[0016] Turning to the drawings, FIG. 6 illustrates an exemplary embodiment of a computer system 600, all of which or a portion of which can be suitable for implementing the techniques described herein. As an example, a different or separate one of a chassis 602 (and its internal components) can be suitable for implementing the techniques described herein. Furthermore, one or more elements of computer system 600 (e.g., a refreshing monitor 606, a keyboard 604, and/or a mouse 610, etc.) can also be appropriate for implementing the techniques described herein. Computer system 600 comprises chassis 602 containing one or more circuit boards (not shown), a Universal Serial Bus (USB) port 612, a Compact Disc Read-Only Memory (CD-ROM) and/or Digital Video Disc (DVD) drive 616, and a hard drive 614. A representative block diagram of the elements included on the circuit boards inside chassis 602 is shown in FIG. 7. A central processing unit (CPU) 710 in FIG. 7 is coupled to a system bus 714 in FIG. 7. In various embodiments, the architecture of CPU 710 can be compliant with any of a variety of commercially distributed architecture families.

[0017] Continuing with FIG. 7, system bus 714 also is coupled to a memory storage unit 708, where memory storage unit 708 comprises both read only memory (ROM) and random access memory (RAM). Non-volatile portions of memory storage unit 708 or the ROM can be encoded with a boot code sequence suitable for restoring computer system 600 (FIG. 6) to a functional state after a system reset. In addition, memory storage unit 708 can comprise microcode such as a Basic Input-Output System (BIOS). In some examples, the one or more memory storage units of the various embodiments disclosed herein can comprise memory storage unit 708, a USB-equipped electronic device, such as, an external memory storage unit (not shown) coupled to universal serial bus (USB)

port 612 (FIGs. 6-7), hard drive 614 (FIGs. 6-7), and/or CD-ROM or DVD drive 616 (FIGs. 6-7). In the same or different examples, the one or more memory storage units of the various embodiments disclosed herein can comprise an operating system, which can be a software program that manages the hardware and software resources of a computer and/or a computer network. The operating system can perform basic tasks such as, for example, controlling and allocating memory, prioritizing the processing of instructions, controlling input and output devices, facilitating networking, and managing files. Some examples of common operating systems can comprise Microsoft® Windows® operating system (OS), Mac® OS, UNIX® OS, and Linux® OS.

[0018] As used herein, "processor" and/or "processing module" means any type of computational circuit, such as but not limited to a microprocessor, a microcontroller, a controller, a complex instruction set computing (CISC) microprocessor, a reduced instruction set computing (RISC) microprocessor, a very long instruction word (VLIW) microprocessor, a graphics processor, a digital signal processor, or any other type of processor or processing circuit capable of performing the desired functions. In some examples, the one or more processors of the various embodiments disclosed herein can comprise CPU 710.

[0019] In the depicted embodiment of FIG. 7, various I/O devices such as a disk controller 704, a graphics adapter 724, a video controller 702, a keyboard adapter 726, a mouse adapter 706, a network adapter 720, and other I/O devices 722 can be coupled to system bus 714. Keyboard adapter 726 and mouse adapter 706 are coupled to keyboard 604 (FIGs. 6-7) and mouse 610 (FIGs. 6-7), respectively, of computer system 600 (FIG. 6). While graphics adapter 724 and video controller 702 are indicated as distinct units in

FIG. 7, video controller 702 can be integrated into graphics adapter 724, or vice versa in other embodiments. Video controller 702 is suitable for refreshing monitor 606 (FIGs. 6-7) to display images on a screen 608 (FIG. 6) of computer system 600 (FIG. 6). Disk controller 704 can control hard drive 614 (FIGs. 6-7), USB port 612 (FIGs. 6-7), and CD-ROM drive 616 (FIGs. 6-7). In other embodiments, distinct units can be used to control each of these devices separately.

[0020] In some embodiments, network adapter 720 can comprise and/or be implemented as a WNIC (wireless network interface controller) card (not shown) plugged or coupled to an expansion port (not shown) in computer system 600 (FIG. 6). In other embodiments, the WNIC card can be a wireless network card built into computer system 600 (FIG. 6). A wireless network adapter can be built into computer system 600 by having wireless communication capabilities integrated into the motherboard chipset (not shown), or implemented via one or more dedicated wireless communication chips (not shown), connected through a PCI (peripheral component interconnector) or a PCI express bus of computer system 600 (FIG. 6) or USB port 612 (FIG. 6). In other embodiments, network adapter 720 can comprise and/or be implemented as a wired network interface controller card (not shown).

[0021] Although many other components of computer system 600 (FIG. 6) are not shown, such components and their interconnection are well known to those of ordinary skill in the art. Accordingly, further details concerning the construction and composition of computer system 600 and the circuit boards inside chassis 602 (FIG. 6) are not discussed herein.

[0022] When computer system 600 in FIG. 6 is running, program instructions stored on a USB-equipped electronic device connected to USB port 612, on a CD-ROM or DVD in CD-ROM and/or DVD drive 616, on hard drive 614, or in memory storage unit 708 (FIG. 7) are executed by CPU 710 (FIG. 7). A portion of the program instructions, stored on these devices, can be suitable for carrying out at least part of the techniques described herein.

[0023] Although computer system 600 is illustrated as a desktop computer in FIG. 6, there can be examples where computer system 600 may take a different form factor while still having functional elements similar to those described for computer system 600. In some embodiments, computer system 600 may comprise a single computer, a single server, or a cluster or collection of computers or servers, or a cloud of computers or servers. Typically, a cluster or collection of servers can be used when the demand on computer system 600 exceeds the reasonable capability of a single server or computer. In certain embodiments, computer system 600 may comprise a portable computer, such as a laptop computer. In certain other embodiments, computer system 600 may comprise a mobile device, such as a smart phone. In certain additional embodiments, computer system 600 may comprise an embedded system.

[0024] FIG. 1 illustrates an embodiment of a system 100 to analyze tempo data. System 100 includes a tempo analysis module 115 and a golf club head weight analysis module 125. In some embodiments, system 100 can be integrated in a device, system, or method such as described in U.S. Patent Pub. No. 2012-0289354, Systems, Methods, and Articles of Manufacture to Measure, Analyze and Share Golf Swing Characteristics, which is hereby incorporated by reference. In some embodiments, system 100 can analyze tempo

data at a portable electronic device 525, for example as shown in FIG. 5. Portable electronic device 525 can be a device such as a cellphone, a portable music player, a global positioning system (GPS) device, a camera, or a gaming device. In some embodiments, portable electronic device 525 can be attached to club 500 at shaft 510 by an attachment 520. In other embodiments, portable electronic device 525 can be attached to a user's belt or in the user's pocket or other location. In other embodiments, system 100 can analyze tempo data at a computer or computing system.

[0025] In some embodiments, returning to FIG. 1, system 100 analyzes tempo data and can include tempo analysis module 115 that can be configured to run on one or more processors. In some embodiments, tempo analysis module 115 can be further configured to receive swing data from a sensor 110. Sensor 110 can also be referred to as a tempo sensor or a swing sensor. In one embodiment, sensor 110 can comprises a sensor array. Sensor 110 or the sensor array can include one or more accelerometers to measure accelerations and/or one or more gyroscopes to determine an orientation of a golf club 500, such as the golf club depicted in FIG. 5, or the measuring device, which can be used to measure swing data.

[0026] In some embodiments, swing data can be generated by averaging data from a user swinging golf club 500 during a putt. In some embodiments, swing data comprises a backswing or upswing time and a downswing time. In some embodiments swing data can be averaged from one putt. In other embodiments, the data can be averaged from the user putting a variety of putts, such as putting at least three or five times at a putt distance of approximately 10 feet or 3 meters from a golf hole.

[0027] In some embodiments, the golf club head weight can have positive effects on a user's putting. In some embodiments, for short putts, the average impact area on a putter's strike face can decrease in size when using a heavy golf club head weight. In other embodiments, the average impact area on a putter's strike face can increase in size for long putts when using a heavy golf club head weight. In many embodiments, this effect can suggest that a lighter putter head can provide a tighter impact location for long putts, but a heavier putter head would tighten the impact location for shorter putts.

[0028] Returning to FIG. 1, in some embodiments, tempo analysis module 115 can be further configured to generate a tempo ratio 120 comprising the backswing time over (or divided by) the downswing time. In one embodiment, tempo ratio 120 for a quick tempo is less than 1.8; tempo ratio 120 for the medium tempo is 1.8 to 2.2; and tempo ratio 120 for the slow tempo is more than 2.2. In another embodiment, tempo ratio 120 for the quick tempo is less than 1.6; tempo ratio 120 for the medium tempo is 1.6 to 2.0; and tempo ratio 120 for the slow tempo is more than 2.0.

[0029] In some embodiments, system 100 also can include a golf club head weight analysis module 125 configured to run on the one or more processors. Golf club head weight analysis module 125 can be further configured to generate a recommended golf club head weight 130 for a golf club head 515 (FIG. 5). In some embodiments, recommended golf club head weight 130 can be determined by at least tempo ratio 120. In various embodiments, recommended golf club head weight 130 is for a putter.

[0030] FIG. 2 further illustrates an embodiment of system 100. Tempo analysis module 115 analyzes swing data and generates tempo ratio 120 (FIG. 1). Tempo ratio 120 (FIG. 1) is received by golf club head weight analysis module 125. Golf club head weight

analysis module 125 then analyzes at least tempo ratio 120 (FIG. 1) and recommends a golf club head weight 130 (FIG. 1) for a golf club head, such as golf club head 515 (FIG. 5).

[0031] In some embodiments, inserts are used to change the golf club head weight. In some embodiments, a light insert can be used in a light or standard golf club head. In some embodiments, the light insert can be made out of aluminum. In other embodiments, a heavy insert can be used in a heavy golf club head. In some embodiments, the heavy insert can be made out of steel or tungsten. Other materials can be used for the light or heavy insert. In some embodiments, the different weight inserts allow alteration of the head weight of a golf club by approximately 23 grams to approximately 30 grams depending on the model.

[0032] In some embodiments, recommended golf club head weight 130 (FIG. 1) can be at least one of a standard golf club head weight 221 or a heavy golf club head weight 222. In some embodiments, the recommended golf club head weight 130 (FIG. 1) can be the standard golf club head weight 221 when tempo ratio 120 (FIG. 1) is a quick tempo 211. In other embodiments, the recommended golf club head weight 130 (FIG. 1) can be the heavy golf club head weight 222 when tempo ratio 120 (FIG. 1) is a medium tempo 212 or a slow tempo 213.

[0033] In some embodiments, standard golf club head weight 221 can also be referred to as a light golf club head weight. In some embodiments, heavy golf club head weight 222 can be between approximately 5 percent and approximately 10 percent heavier than standard golf club head weight 221. In other embodiments, standard golf club head weight 221 can be approximately 350 grams or less. In other embodiments, heavy golf

club head weight 222 can be approximately 363 grams or more. For example, in a blade style putter, standard golf club head weight 221 can be approximately 340 grams, and heavy golf club head weight 222 can be approximately 363 grams. In another blade style putter, standard golf club head weight 221 can be approximately 350 grams, and the heavy golf club head weight 222 can be approximately 375 grams. As another example, in a mid-mallet style putter, standard golf club head weight 221 can be approximately 345 grams to 352 grams, and heavy golf club head weight 22 can be approximately 375 grams. In another mid-mallet style putter, standard golf club head weight 221 can be approximately 340 grams, and heavy golf club head weight 222 can be approximately 363 grams. As another example, for a mallet style putter, standard golf club head weight 221 can be approximately 350 grams, and heavy golf club head weight 222 can be approximately 380 grams. In another mallet style putter, standard golf club head weight 221 can be approximately 345 grams, and heavy golf club head weight 222 can be approximately 375 grams.

[0034] In some embodiments, golf club head weight analysis module 125 can be further configured to modify the recommended golf club if a modifier is present. In some embodiments, the modifier can be a modifier such as green speed, wet or dry greens, type of golf ball, user handling, user yips or jerks on impact with the golf ball, or styles of putters. In one embodiment, as shown in FIG. 3, a system 300 for analyzing tempo data can include a modifier such as a user struggling with a short putt 321 or a long putt 322. Golf club head weight analysis module 125 can be further configured to determine if the user struggles with short putt 321 or long putt 322.

[0035] In some embodiments, determining if the user struggles with short putt 321 or long putt 322 comprises the user making a selection as to whether the user struggles with short putt 321 or long putt 322. For example, the system could ask a question such as "Do you suffer from inconsistent putting from any of the following distances?" with the options to answer "short," "long," "none," or "short and long."

[0036] In other embodiments, determining if the user struggles with short putt 321 or long putt 322 comprises a putt analysis module configured to analyze putt data after the user completes a variety of putts. In some embodiments the user can complete at least 3 or 5 short putts and at least 3 or 5 long putts, or at least 3 putts each. In some embodiments, short putt 321 can be approximately 10 feet or less and long putt 322 can be more than 10 feet. In the present embodiment, golf club head weight analysis module 125 can be further configured to recommend heavy golf club head weight 222 if the user struggles with short putt 321 and has quick tempo 211, standard golf club head weight 221 if the user struggles with long putt 322 and has medium tempo 212, or a counter balance 323 if the user struggles with short putt 321 and has slow tempo 213 or medium tempo 212. In some embodiments, counter balance 323 can be between approximately 400 grams and approximately 425 grams. In other embodiments, golf club head weight analysis module 125 can recommend a long putter instead of counter balance 323. In some embodiments, if the user has quick tempo 211 and struggles with a long putt, system 300 can recommend the original standard golf club head weight 221 (FIG. 2). Similarly, if the user has slow tempo 213 and struggles with a long putt, system 300 can recommend the original heavy golf club head weight 222 (FIG. 2).

[0037] In some embodiments, a feedback loop or other iterative process can be used to verify or change recommended golf club head weight 130 (FIG. 1). For example, after recommended golf club head weight 130 (FIG. 1)is provided, the user can putt a variety of putts and tempo analysis module 115 can analyze the swing data received from sensor 110 and generate tempo ratio 120 (FIG. 1). If tempo ratio 120 (FIG. 1) has changed or if a modifier such as struggling with short putt 321 or long putt 322 changes, a new recommended golf club head weight 130 (FIG. 1) can be generated.

[0038] In some embodiments, system 100, 200, or 300 of FIGs. 1, 2, and 3 can compare the user's tempo ratio 120 (FIG. 1) to another user's tempo ratio 120 (FIG. 1) in a database. For example, a user's tempo ratio 120 (FIG. 1) can be compared to a friend or a professional golfer in the database.

[0039] FIG. 4 illustrates a method 400 to determine a recommended golf club head weight 130 (FIG. 1). In some embodiments, method 400 comprises a step 401 for executing tempo analysis module 115 (FIG. 1) on one or more processors to receive swing data and generate tempo ratio 120 (FIG. 1), step 402 for executing golf club head weight analysis module 125 (FIG. 1) on the one or more processors to receive tempo ratio 120 (FIG. 1) and generate a recommended golf club head weight 130 (FIG. 1), and step 404 for executing a display module on the one or more processors to receive the recommended golf club head weight 130 (FIG. 1) from golf club head weight analysis module 125 (FIG. 1) and displaying the recommended golf club head weight 130 (FIG. 1) to the user. In some embodiments, generating the recommended golf club head weight 130 (FIG. 1) is for a putter.

[0040] In various embodiments, method 400 further comprises step 403 for changing or altering recommended golf club head weight 130 (FIG. 1) if a modifier is present. In some embodiments, the modifier can be for when a user struggles with a short putt or a long putt, such as illustrated in FIG. 3.

[0041] In some embodiments, a further step for a feedback loop or other iterative process can be used in method 400 of FIG. 4 to verify or change recommended golf club head weight 130 (FIG. 1). For example, after recommended golf club head weight 130 (FIG. 1) is provided, the user can putt a variety of putts and tempo analysis module 115 (FIG. 1) can analyze the swing data received from sensor 110 (FIG. 1) and generate tempo ratio 120 (FIG. 1). If tempo ratio 120 (FIG. 1) has changed or if a modifier such as struggling with short putt 321 (FIG. 3) or long putt 322 (FIG. 3) changes, a new recommended golf club head weight 130 (FIG. 1) can be generated.

[0042] Although a particular order of actions is illustrated in FIGs. 3-4, these actions may be performed in other temporal sequences. For example, the actions depicted in FIGs. 3-4 may be performed sequentially, concurrently, or simultaneously.

[0043] Additional examples of such changes have been given in the foregoing description. Accordingly, the disclosure of embodiments of systems and methods for fitting golf club head weight is intended to be illustrative of the scope of systems and methods for fitting golf club head weight and is not intended to be limiting. For example, in one embodiment, a system and method for fitting golf club head weight may have one or more features of FIG. 1, with or without the features described with reference to FIGs. 2-5. Other permutations of the different embodiments having one or more of the features of the various figures are likewise contemplated. It is intended that the scope of systems

and methods for fitting golf club head weight shall be limited only to the extent required by the appended claims.

[0044] The systems and methods for fitting golf club head weight discussed herein may be implemented in a variety of embodiments, and the foregoing discussion of these embodiments does not necessarily represent a complete description of all possible embodiments. Rather, the detailed description of the drawings, and the drawings themselves, disclose at least one preferred embodiment of systems and methods for fitting golf club head weight, and may disclose alternative embodiments of systems and methods for fitting golf club head weight.

[0045] All elements claimed in any particular claim are essential to systems and methods for fitting golf club head weight claimed in that particular claim. Consequently, replacement of one or more claimed elements constitutes reconstruction and not repair. Additionally, benefits, other advantages, and solutions to problems have been described with regard to specific embodiments. The benefits, advantages, solutions to problems, and any element or elements that may cause any benefit, advantage, or solution to occur or become more pronounced, however, are not to be construed as critical, required, or essential features or elements of any or all of the claims.

[0046] Moreover, embodiments and limitations disclosed herein are not dedicated to the public under the doctrine of dedication if the embodiments and/or limitations: (1) are not expressly claimed in the claims; and (2) are or are potentially equivalents of express elements and/or limitations in the claims under the doctrine of equivalents.

CLAIMS

What is claimed is:

1. A system to analyze tempo data, the system comprising:

a tempo analysis module configured to run on one or more processors, and further configured to:

receive swing data from a tempo sensor, the swing data comprising:

a backswing time; and

a downswing time;

and

generate a tempo ratio comprising the backswing time over the downswing time;

and

a golf club head weight analysis module configured to run on the one or more processors, and further configured to generate a recommended golf club head weight determined by at least the tempo ratio.

2. The system of claim 1, wherein:

the recommended golf club head weight is for a putter.

3. The system of claim 1, wherein:

the tempo sensor comprises a sensor array.

4. The system of claim 1, wherein:

the swing data is generated by averaging data from a user putting at least 3 times at a distance of approximately 10 feet from a golf hole.

5. The system of claim 1, wherein:

the recommended golf club head weight is at least one of a standard golf club head weight or a heavy golf club head weight.

6. The system of claim 5, wherein at least one of:

the heavy golf club head weight is approximately 5 percent to approximately 10 percent heavier than the standard golf club head weight;

the standard golf club head weight is approximately 350 grams or less;

or

the heavy weight is approximately 363 grams or more.

7. The system of claim 5, wherein:

the recommended golf club head weight is the standard golf club head weight when the tempo ratio is a quick tempo;

and

the recommended golf club head weight is the heavy golf club head weight when the tempo ratio is a medium tempo or a slow tempo.

8. The system of claim 7, wherein:

the tempo ratio for the quick tempo is less than 1.8;

the tempo ratio for the medium tempo is 1.8 to 2.2;

and

the tempo ratio for the slow tempo is more than 2.2.

9. The system of claim 7, wherein:

the tempo ratio for the quick tempo is less than 1.6;

the tempo ratio for the medium tempo is 1.6 to 2.0;

and

the tempo ratio for the slow tempo is more than 2.0.

10. The system of claim 1, wherein:

the golf club head weight analysis module is further configured to modify the recommended golf club head weight if a modifier is present.

11. The system of claim 10, wherein:

the modifier is a user struggling with a short putt or a long putt;

and

the golf club head weight analysis module is further configured to:

determine if the user struggles with the short putt or the long putt;

and

recommend:

the heavy golf club head weight if the user struggles with the short putt and has the quick tempo;

the standard golf club head weight if the user struggles with the long putt and has the medium tempo;

or

a counter balance if the user struggles with the short putt and has the slow tempo or the medium tempo

12. The system of claim 11, wherein:

determining if the user struggles with the short putt or the long putt comprises at least one of:

the user selecting whether the user struggles with the short putt or the long putt;

or

a putt analysis module configured to analyze putt data after the user completes at least 3 short putts and at least 3 long putts.

13. The system of claim 11, wherein:

short putts are approximately 10 feet or less;

and

long putts are more than 10 feet.

14. A method to determine a recommended golf club head weight, the method comprising:

executing a tempo analysis module on one or more processors to:

receive swing data from a swing sensor, the swing data comprising:

a backswing time; and

a downswing time; and

generate a tempo ratio comprising the backswing time over the downswing time;

executing a golf club head weight analysis module on the one or more processors to:

receive the tempo ratio from the tempo analysis module; and

generate a recommended golf club head weight determined by at least the tempo ratio; and

executing a display module on the one or more processors to:

receive the recommended golf club head weight from the golf club head weight analysis module; and

display the recommended golf club head weight to a user.

15. The method of claim 14, wherein:

generating the recommended golf club head weight is for a putter.

16. The method of claim 14, wherein:

receiving the swing data from the swing sensor comprises receiving the swing data from a sensor array.

17. The method of claim 14, wherein:

generating the recommended golf club head weight comprises recommending at least one of a standard golf club head weight or a heavy golf club head weight;

and at least one of:

the heavy golf club head weight is approximately 5 percent to approximately 10 percent heavier than the standard golf club head weight;

the standard golf club head weight is approximately 350 grams or less;

or

the heavy weight is approximately 363 grams or more.

18. The method of claim 14, wherein:

generating the recommended golf club head weight comprises:

recommending the standard golf club head weight when the tempo ratio is a quick tempo;

and

recommending the heavy golf club head weight when the tempo ratio is a medium tempo or a slow tempo.

19. The method of claim 18, wherein:

the tempo ratio for the quick tempo is less than 1.8;

the tempo ratio for the medium tempo is 1.8 to 2.2;

and

the tempo ratio for the slow tempo is more than 2.2.

20. The method of claim 18, wherein:

the tempo ratio for the quick tempo is less than 1.6;

the tempo ratio for the medium tempo is 1.6 to 2.0;

and

the tempo ratio for the slow tempo is more than 2.0.

21. The method of claim 18, wherein:

executing the golf club head weight analysis module on the one or more processors further comprises to modify the recommended golf club head weight if a modifier is present.

22. The method of claim 21, wherein:

the modifier is a user struggling with a short putt or a long putt;

and

executing the golf club head weight analysis module on the one or more processors to modify the recommended golf club head weight if the modifier is present, comprises:

determining if the user struggles with the short putt or the long putt;

and

recommending:

the heavy golf club head weight if the user struggles with the short putt and has the quick tempo;

the standard golf club head weight if the user struggles with the long putt and has the medium tempo;

or

a counter balance if the user struggles with the short putt and has the slow tempo or the medium tempo.

23. The method of claim 22, wherein:

determining if the user struggles with the short putt or the long putt comprises at least one of:

the user selecting whether the user struggles with the short putt or the long putt;

or

analyzing putt data after the user completes at least 5 short putts and at least 5 long putts.

24. The method of claim 14, wherein:

the swing data is generated by averaging data from a user putting at least 3 times at a distance of approximately 10 feet from a golf hole.

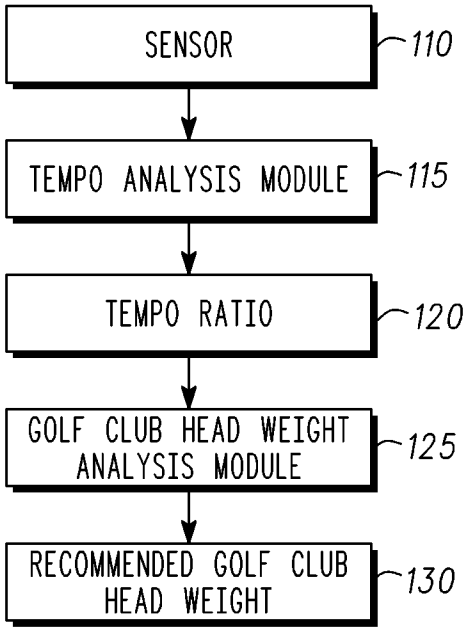

SENSOR
110
TEMPO ANALYSIS MODULE
115
TEMPO RATIO
120
GOLF CLUB HEAD WEIGHT ANALYSIS MODULE
125
RECOMMENDED GOLF CLUB HEAD WEIGHT
130
100

Fig. 1

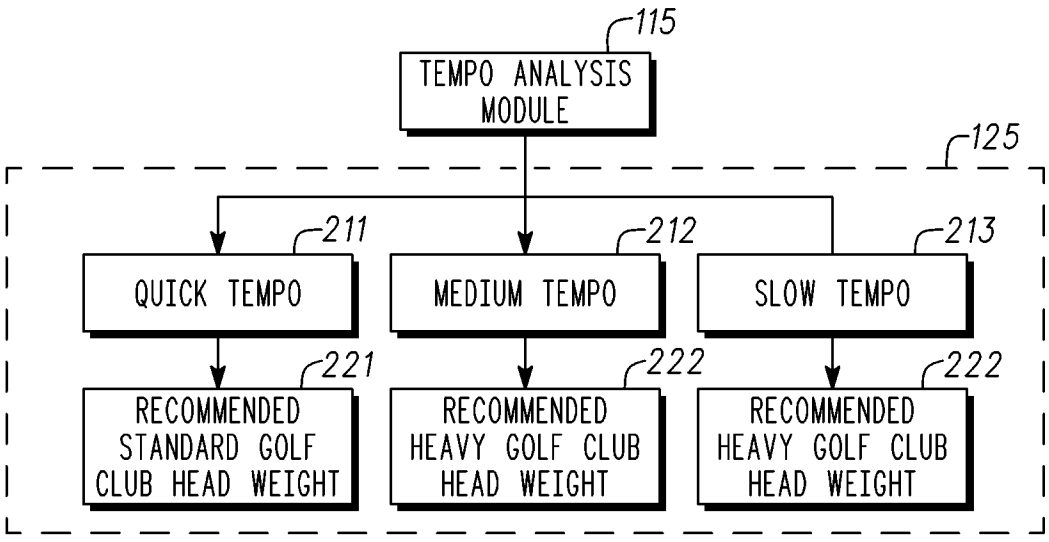

115
TEMPO ANALYSIS MODULE
125
211
212
213
QUICK TEMPO
MEDIUM TEMPO
SLOW TEMPO
221
222
222
RECOMMENDED STANDARD GOLF CLUB HEAD WEIGHT
RECOMMENDED HEAVY GOLF CLUB HEAD WEIGHT
RECOMMENDED HEAVY GOLF CLUB HEAD WEIGHT
100

Fig. 2

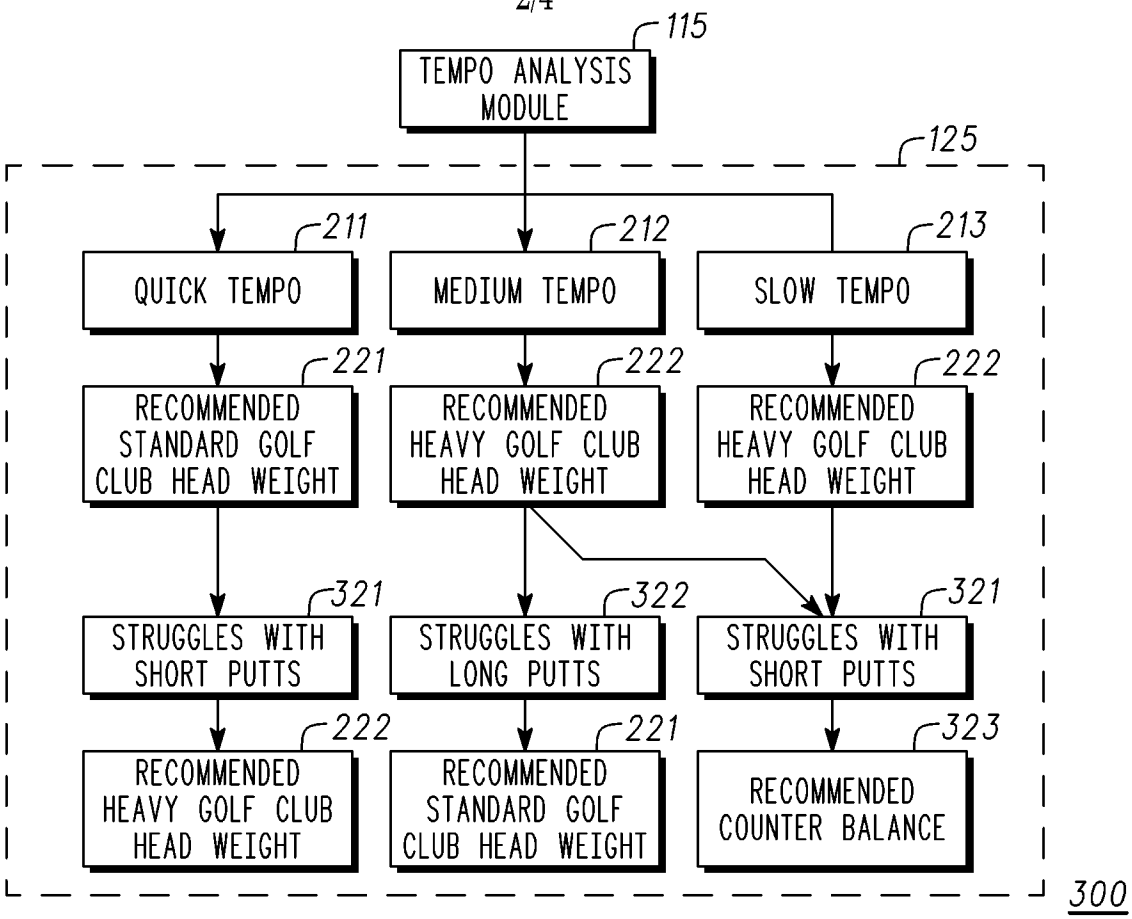

115
TEMPO ANALYSIS MODULE
125
211
212
213
QUICK TEMPO
MEDIUM TEMPO
SLOW TEMPO
221
222
222
RECOMMENDED STANDARD GOLF CLUB HEAD WEIGHT
RECOMMENDED HEAVY GOLF CLUB HEAD WEIGHT
RECOMMENDED HEAVY GOLF CLUB HEAD WEIGHT
321
322
321
STRUGGLES WITH SHORT PUTTS
STRUGGLES WITH LONG PUTTS
STRUGGLES WITH SHORT PUTTS
222
221
323
RECOMMENDED HEAVY GOLF CLUB HEAD WEIGHT
RECOMMENDED STANDARD GOLF CLUB HEAD WEIGHT
RECOMMENDED COUNTER BALANCE
300

Fig. 3

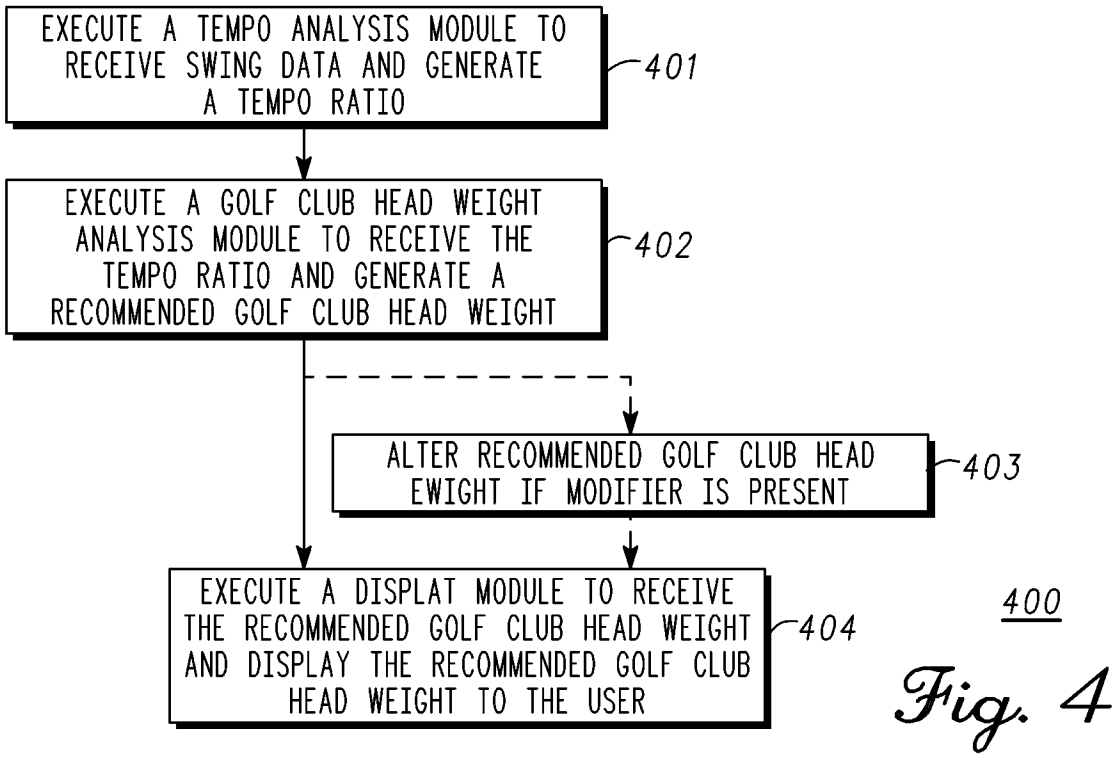

EXECUTE A TEMPO ANALYSIS MODULE TO RECEIVE SWING DATA AND GENERATE A TEMPO RATIO
401
EXECUTE A GOLF CLUB HEAD WEIGHT ANALYSIS MODULE TO RECEIVE THE TEMPO RATIO AND GENERATE A RECOMMENDED GOLF CLUB HEAD WEIGHT
402
ALTER RECOMMENDED GOLF CLUB HEAD EWIGHT IF MODIFIER IS PRESENT
403
EXECUTE A DISPLAT MODULE TO RECEIVE THE RECOMMENDED GOLF CLUB HEAD WEIGHT AND DISPLAY THE RECOMMENDED GOLF CLUB HEAD WEIGHT TO THE USER
404
400

Fig. 4

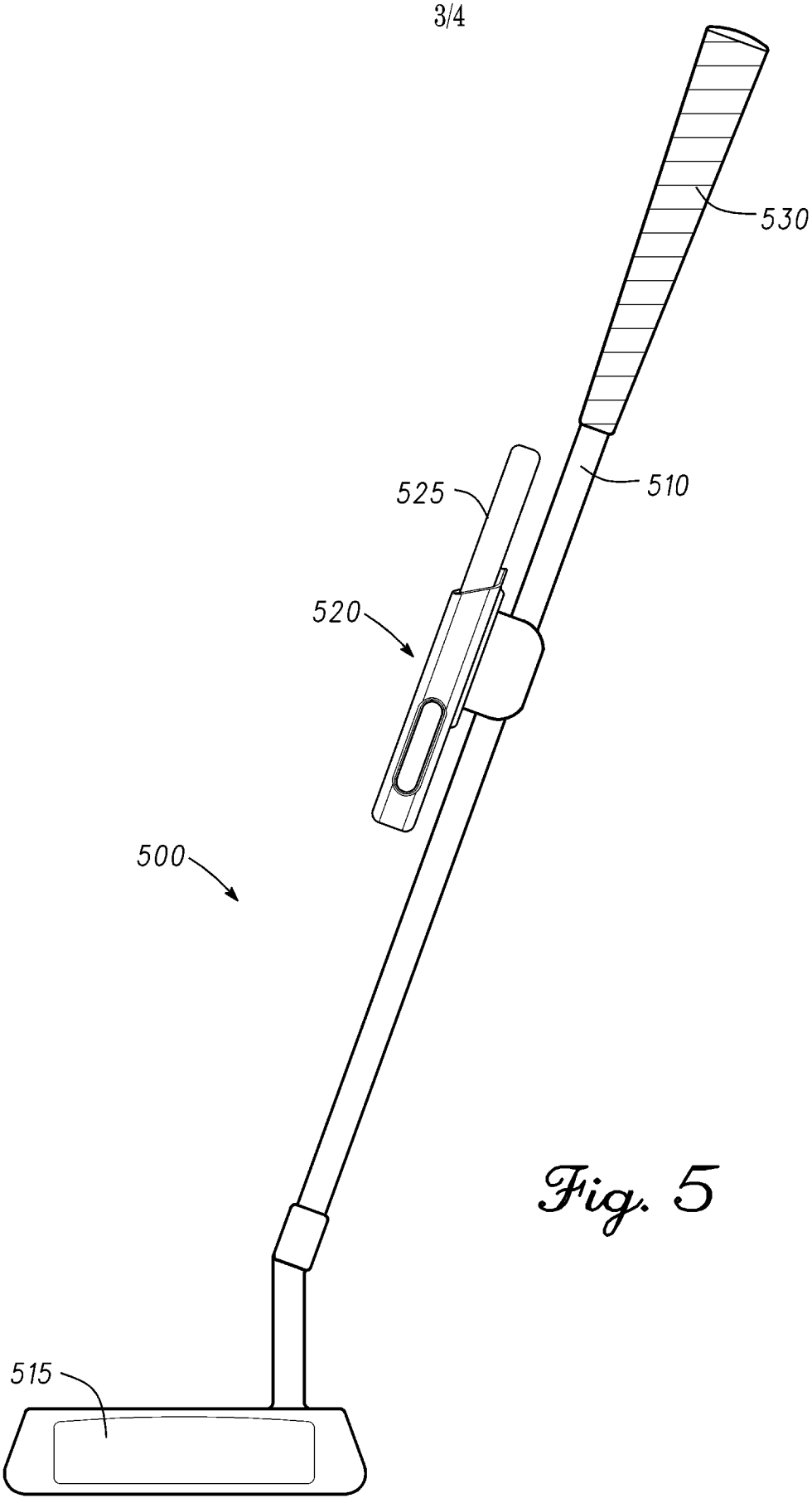


Fig. 5

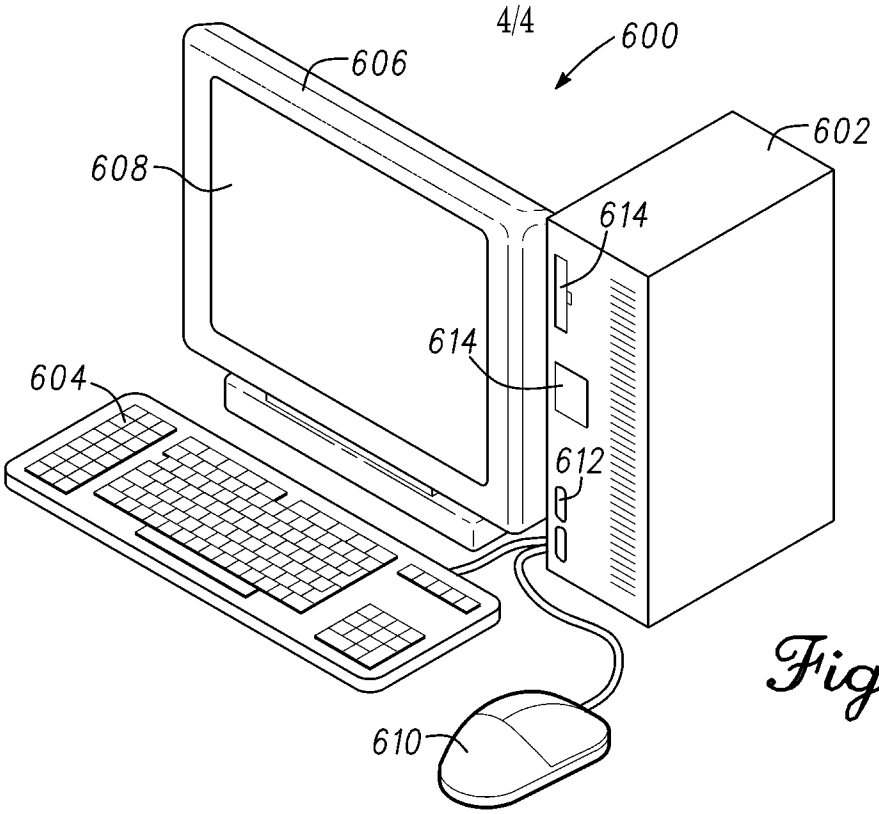
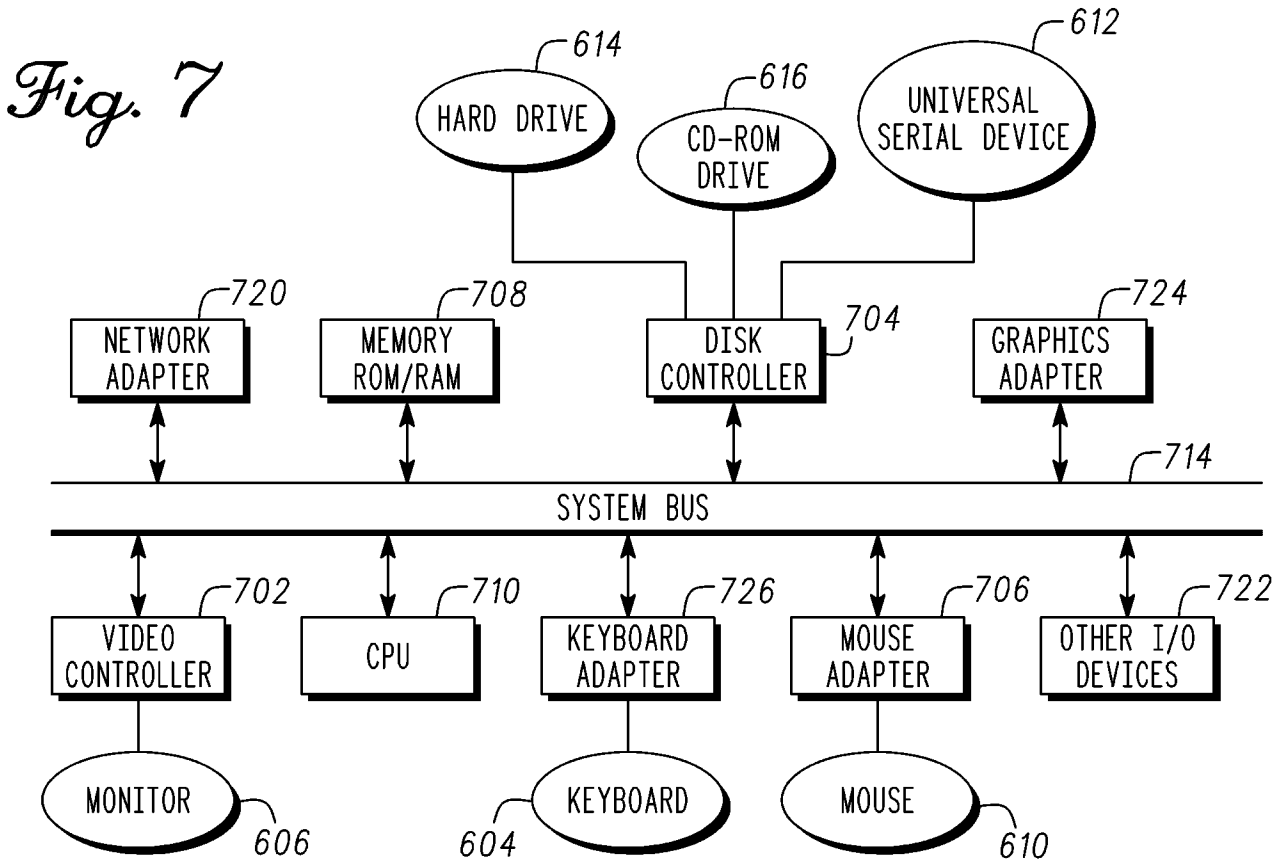

600
606
602
608
614
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604
612
610

Fig. 6

Fig. 7


614
HARD DRIVE
616
CD-ROM DRIVE
612
UNIVERSAL SERIAL DEVICE
720
NETWORK ADAPTER
708
MEMORY ROM/RAM
704
DISK CONTROLLER
724
GRAPHICS ADAPTER
714
SYSTEM BUS
702
VIDEO CONTROLLER
710
CPU
726
KEYBOARD ADAPTER
706
MOUSE ADAPTER
722
OTHER I/O DEVICES
MONITOR
606
KEYBOARD
604
MOUSE
610

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US15/60985

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A63B 53/00, 53/04, 53/06 (2016.01)
CPC - A63B 53/0487
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) Classification(s): A63B 53/00, 53/02, 53/04, 53/06, 69/36 (2016.01)
CPC Classification(s): A63B 53/007, 53/02, 53/0487, 53/064, 2053/0433, 2053/0441, 2053/0491

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC Classification(s): 473/251, 313, 336, 340, 341

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PatSeer (US, EP, WO, JP, DE, GB, CN, FR, KR, ES, AU, IN, CA, INPADOC Data): golf, putter, tempo, rhythym, ratio, backswing, backstroke, downswing, downstroke, forward swing, forward stroke, weight, gram, mass, quick, fast, slow, heavy, light, standard, average

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X --- Y	US 2012/0289354 A1 (COTTAM, R.J. et al.) November 15, 2012; paragraphs [0074], [0075], [0107], [0189]	1-5, 14-16, 24 --- 6-13, 17-23
Y	'Putters: Heavy or Light?' The Sand Trap (TOURSPOON). 18 December 2011. Retireved from the Internet. Retrieved on 07 January 2016. URL: <http://thesandtrap.com/forums/topic/54778-putters-heavy-or-light/>	6-13, 17-23
Y	'How to use a Metronome for Putting Tempo Practice' Golf WRX (TEMPOMAN). March 16, 2009. Retrieved from the Internet. Retrieved on 07 January 2016. URL: <http://www.golfwrx.com/forums/topic/238614-how-to-use-a-metronome-for-putting-tempo-practice/>	8, 9, 19, 20
A	WO 2014/092213 A1 (DU-SUNG TECHNOLOGY CO LTD) 19 June 2014; entire document	1-24
A	US 2011/0143866 A1 (MCCONNELL W. D.) June 16, 2011; entire document	1-24
A	US 2006/0166738 A1 (EYESTONE R. D. et al.) July 27, 2006; entire document	1-24

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
08 January 2016 (08.01.2016)	28 JAN 2016
Name and mailing address of the ISA/ Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Shane Thomas PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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