

- [54] SWING-ACCOMMODATION APPARATUS
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[51] Int. Cl. **A63b 69/36**
[58] Field of Search **273/186, 190, 191, 192;**
35/29; 73/13

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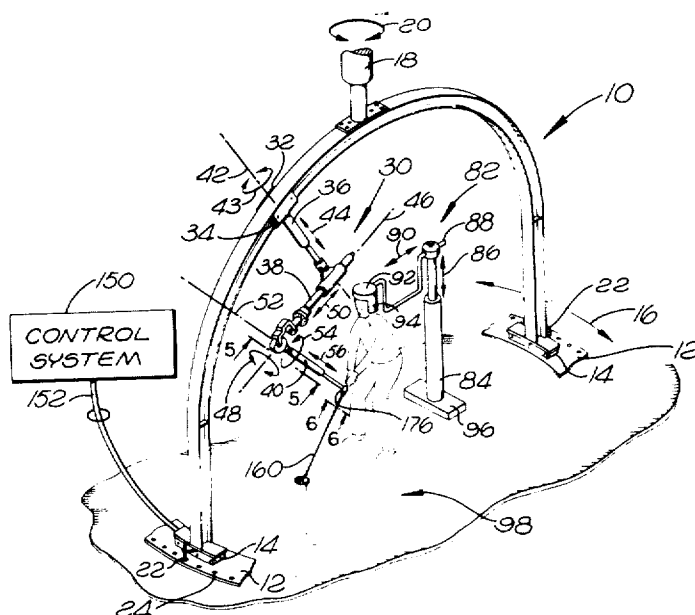
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[57] **ABSTRACT**

A device for training a user to properly swing an implement such as a golf club. The device includes an overhead arched support mounted on rollers, which support is adapted to be rotated about a fixed axis to

selected positions on a supporting surface. Extending downward from the support, and slideable therealong, is a mechanical system including three movably interconnected shafts, the lowermost one of which is adapted to be connected to the implement to be swung. The system functions: (a) to follow the swing of one who is engaging in a sports activity, (b) through power application, to cause one to emulate the swing for a given sports activity, (c) provide the function of a swing as it would be carried out in a sports activity without the necessity of a user being present, or (d) a combination of the foregoing. A system including hydraulic fluid, valves, electrical sensors and electrical actuators is provided either for detecting movements of the shafts or causing selected movements of the shafts. When the device is adjusted so that no resistance is offered to movements of the club implement, the shafts permit the club implement to be moved along its axis, about its axis, and in all planes relative to its axis, including planes orthogonal to each other. The principles of operation of the device maybe illustrated by attaching a flexible cord to a point on an inverted cone located above a golfer, and securing the other end of the cord to a point adjacent the head of a golf club. The axis of the cone is positioned such that the effective length of the cord (if kept taut) is shortened and lengthened as it is wrapped and unwrapped around the cone during the execution of the backswing and downswing with the club. Also disclosed is a helmet-like device for restraining movements of the golfer's head.

9 Claims, 9 Drawing Figures



SHEET 1 OF 3

FIG. 1.

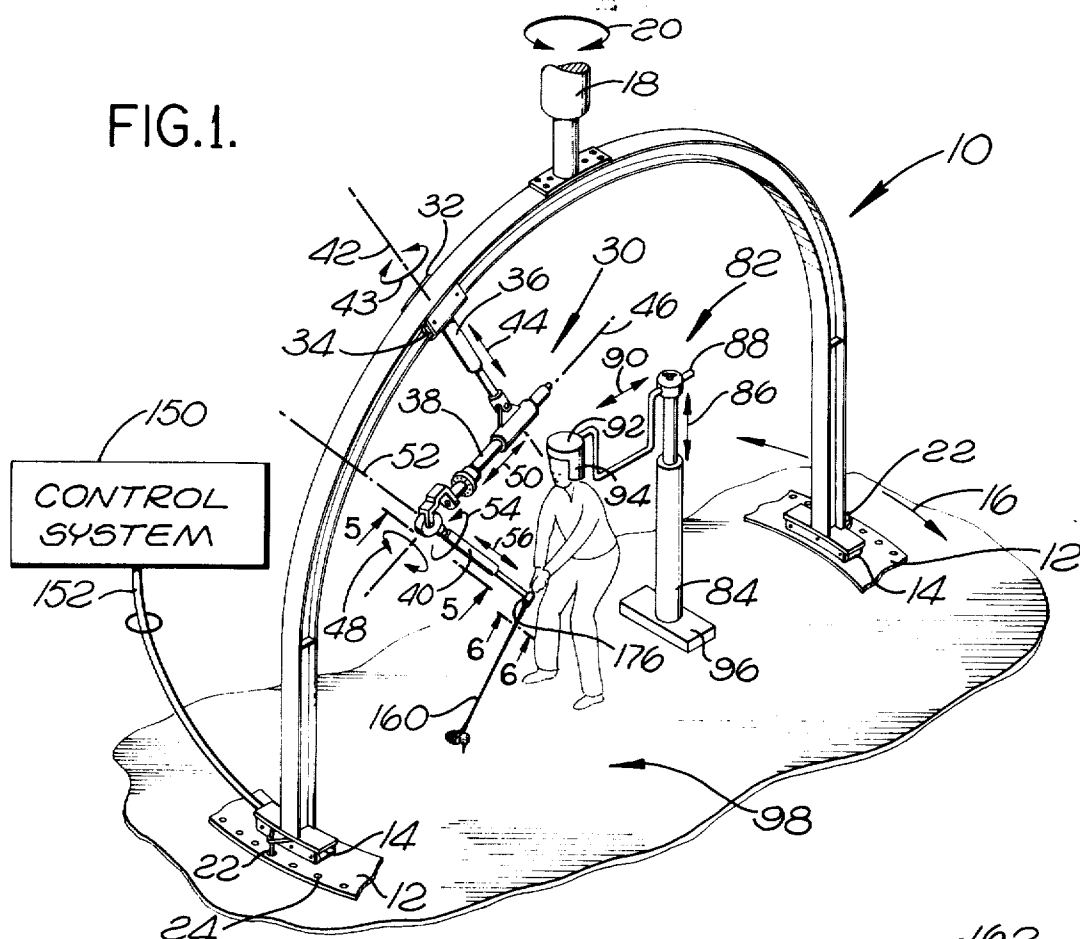
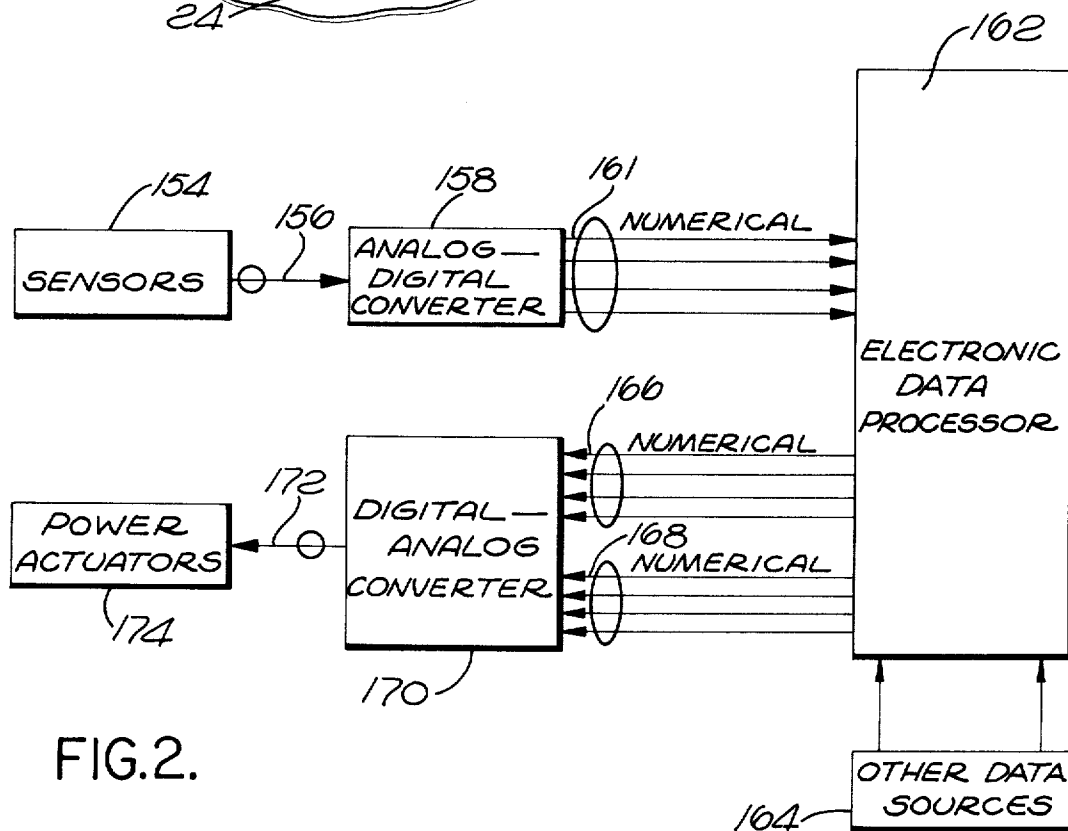
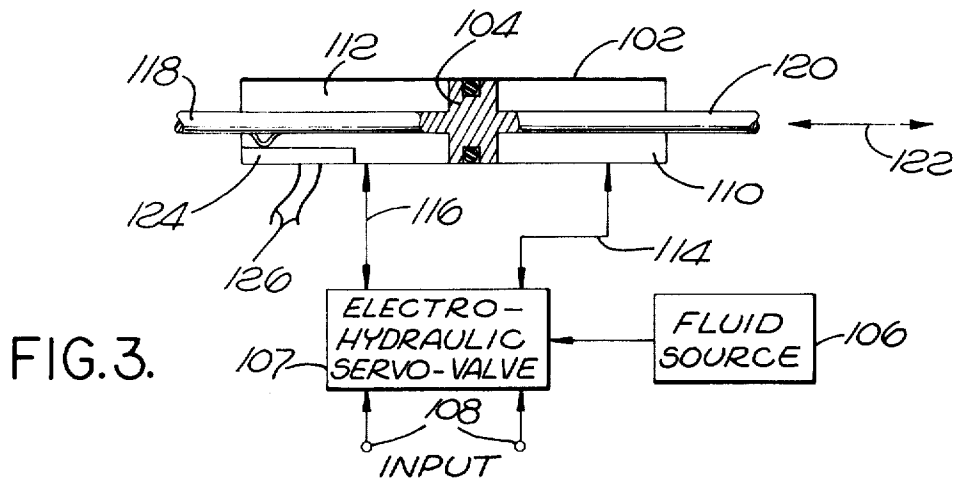
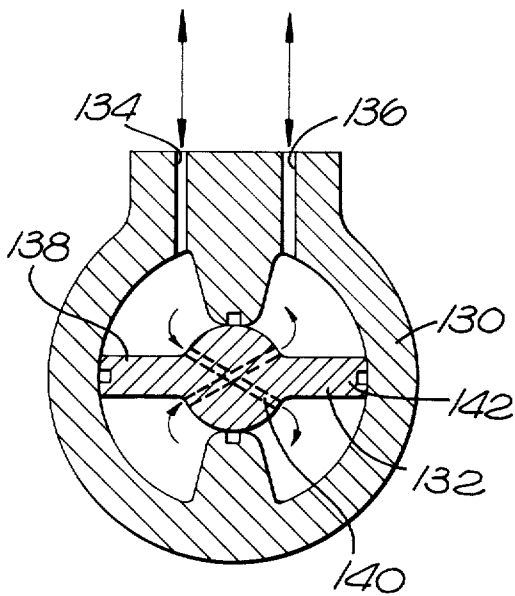
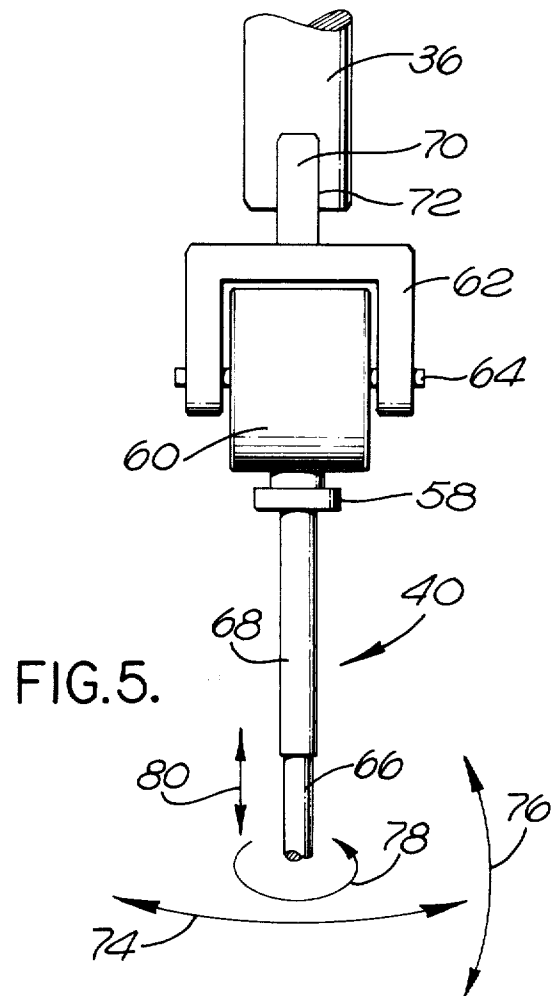


FIG. 2.



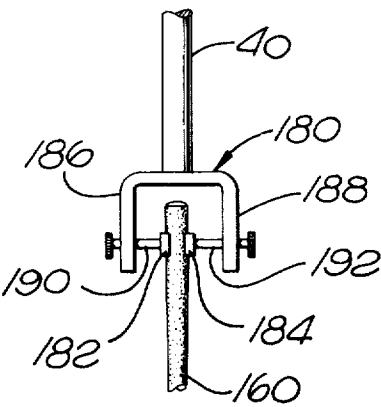


FIG. 6.

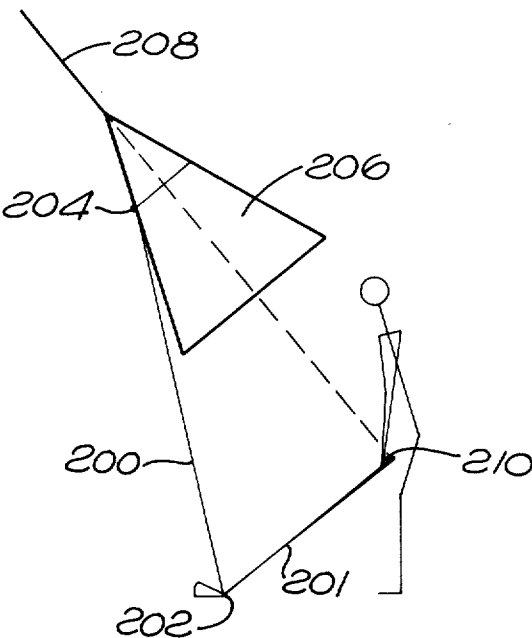


FIG. 7A.

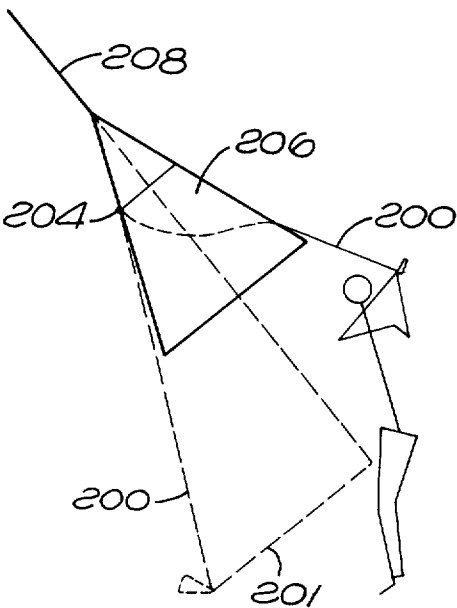


FIG. 7B.

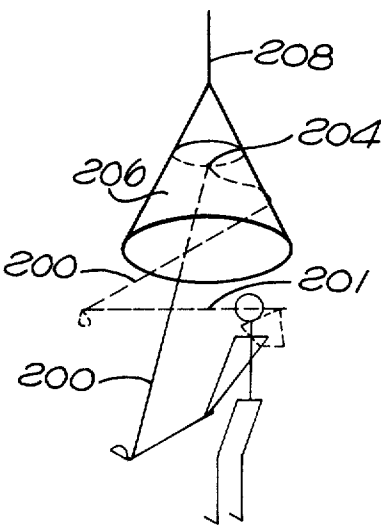


FIG. 7C.

SWING-ACCOMMODATION APPARATUS

BACKGROUND OF THE INVENTION

It has long been desired in various sporting events where a particular motion such as a swing is utilized to provide apparatus whereby a participant may be instructed in the correct swing for accomplishing the object of the game. Such is particularly true where the participant utilizes an object to strike a ball such for example as in golf, baseball, cricket, tennis or the like. Such however is also desirable in those sports where the participant projects a ball or similar apparatus toward a predetermined target such as in bowling or the like.

Much prior art apparatus has been developed in an attempt to accomplish the foregoing. Such apparatus traditionally falls in two classes, either that which is worn by the participant and is connectable to the object being manipulated by him, or that which is attachable to the object being manipulated by the participant to control movement of the same. Irrespective of into which prior art apparatus falls, it is limited with few exceptions (see patent 3,595,583) to a structure wherein the movement of the structure to be swung by the participant is restricted to a predetermined path of movement. For example, see U.S. Pat. Nos. 3,604,712; 1,567,530; 3,319,963; 3,415,523; 3,415,524; 3,419,277; and Canadian Pat. No. 708,502.

SUMMARY OF THE INVENTION

The present invention provides a significant advance in the art relating to training devices for use by participants in sporting events. The present invention accommodates all of the various complexities of the swing irrespective of the sport in which the same is utilized. That is, the swing may be accommodated even in a sport having a swing as complex as that of golf wherein the club may travel through a continuously changing swing plane and which changes may themselves change depending upon the particular club or the various parameters dictating the required shot to be executed, even when the same club is utilized from shot to shot. Not only will the present invention accommodate such variations, but may be actuated to guide the user thereof through a predetermined swing commensurate with a particular set of parameters dictating such swing.

A swing-accommodating apparatus in accordance with the present invention includes fixed support means, swing-accommodator means for connection to an instrument to be swung, and means interconnecting the support means and the swing-accommodator means.

In other particular aspects of the apparatus in accordance with the present invention, sensor means are operatively associated so as to detect movements representative of the swing and to generate output signals representative of such movement. The signals generated may be assimilated and applied to a computing apparatus for analysis of the user's swing. Such analysis may result in a comparison with swings of others or earlier swings of the user to determine the relationship of the user's swing to an ideal or to plot improvement by the user as a result of his practice.

In accordance with other aspects of the present invention, the apparatus may have associated therewith an actuating device which, subject to input signals, may

position the members so as to cause the apparatus to pass through the various positions representative of a predetermined swing with or without a user gripping the instrument. Under such circumstances, when a user is in position, the user may grip the instrument and passively follow its movement as generated by the swing-accommodating apparatus and the actuators thereto so as to sense the desired movements to accomplish the predetermined swing. The apparatus may be caused to provide timing and sequence to the swing with the user providing the motive power through swinging the instrument affixed to the apparatus. Alternatively, the apparatus may be used for striking an object (ball) with the sporting device (club) without a user holding the club.

In accordance with yet other detailed aspects of the present invention, the apparatus may be utilized in such a manner that the sensor, the computer and the actuating apparatus are all simultaneously operative, thereby causing the sensors to detect actual movement as generated by the user of the apparatus, the computer to compare the same with a predetermined swing that is to be generated by the actuator devices and as a result of any discrepancies, provide signals to correct the positioning of the object which is being gripped by the user, thus causing the user to recognize discrepancies between his swing and that which he desires to accomplish, thereby enabling him to correct the same. As will be evident to those skilled in the art, the apparatus may provide an audible or visual signal when the user deviates from the programmed swing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic illustration of one form which apparatus constructed in accordance with the present invention may take.

FIG. 2 is a schematic representation in block form illustrating utilization of signals developed in accordance with the apparatus in accordance with the present invention.

FIGS. 3 and 4 are schematic representations of sensors and actuators as utilized in accordance with the present invention.

FIG. 5 is a more detailed view of a portion of the apparatus taken along the line 5—5 of FIG. 1.

FIG. 6 is a more detailed fragmentary view of a portion of the apparatus taken along the line 6—6 of FIG. 1.

FIGS. 7A, 7B and 7C are schematic illustrations of the operating principles of the apparatus of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

Apparatus constructed in accordance with the present invention includes a support member shown generally at 10 mounted upon a base 12 which in turn is supported upon rollers 14 or the like so as to be positionable as illustrated by the arrow 16. Such positioning may be accomplished through the application of motive power to a drive member 18 or the like as is indicated by the arrow 20. When properly positioned, the support member may be fixed in place by pins 22 which are inserted into openings 24 in the base 12.

A swing accommodator 30 depends from the support member 10. The term "swing accommodator" as used throughout the specification and claims is intended to mean apparatus which functions to (a) follow the swing

of one who is engaging in a sports activity, (b) through power application to cause one to emulate the swing for a given sports activity, (c) provide the function of a swing as it would be carried out in a sports activity without the necessity of a user being present, or (d) a combination of the foregoing.

The swing accommodator 30 is adjustably secured to the support member 10 by a bracket 32. The bracket 32 includes rollers, gears or the like 34 which engage the support member 10 and may be utilized for movement of the swing accommodator 30 relative to the support member 10. Once the swing accommodator 30 is positioned as desired (as will be described more fully hereinbelow), the bracket 32 may be locked in position.

The primary function of the swing accommodator 30 is to provide apparatus which will grip a sports item that is to be swung and to provide a reference for or define the arc of the swing. Each particular swing for a given sport, for example, tennis, baseball or golf, has a different reference about which the swing may generally be constructed. This reference will vary from sport to sport in its position and may, depending upon the particular swing to be utilized, vary in its position as the particular swing to be accommodated within the sport changes. For purposes of description of the apparatus of the present invention, a golf swing will be used as the example, it being however understood that such example is not to be taken by way of limitation on the present invention.

The swing accommodator as illustrated in the embodiment of FIG. 1 includes first, second and third shafts 36, 38 and 40, respectively. The shaft 36 provides a rotational movement about its axis 42 as is shown by the arrow 43 and is also positionable in a linear fashion along its axis as is illustrated by the arrow 44. The shaft 38 is rotatable about its axis 46 as is indicated by the arrow 48, and in addition thereto, is linearly movable along its axis as is indicated by the arrow 50. The shaft 40 is rotatable about its axis 52 as is indicated by the arrow 54, and in addition thereto is linearly movable along its axis as is indicated by the arrow 56.

The shaft 40 is connected to be a bushing 58 (FIG. 5) which is journaled into a wheel 60 to provide the rotation of the shaft 40 about its axis. The wheel 60 is received within a yoke 62 and is rotatably supported upon an axle 62 so as to be freely rotatable thereabout. The shaft 40 is extensible in that a reduced diameter portion 66 thereof is telescopically received within the upper portion 68 thereof for a purpose to be more fully described hereinbelow. The shaft 38 (not shown in FIG. 5) is connected by way of a tongue 70 which fits within a groove 72 provided in the lower portion of the shaft 36. As will be recalled, the yoke 62 is supported upon the end of the shaft 38 which is rotatable about its axis 46. Thus, it may be seen that the shaft 40 is free to move as indicated by the arrows 74, 76, 78 and 80, as a result of the manner in which it is mounted. The movement represented by arrows 74 and 76 may be described as being in planes orthogonally disposed to each other. The movement represented by the arrow 80 may be described as an effective extension or retraction of the shaft 40 and may be accomplished by the telescoped construction of the shaft 40. However, the same effective movement may be obtained with the apparatus of the present invention through manipulation

of the various axes and shafts. For example, the shaft 40 may remain of fixed (non-telescoping) length and the shaft 38 be allowed to move along its axis 46 as well as to rotate as shown by the arrows 50 and 48 respectively; or, the shaft 36 may be locked to preclude rotational movement thereof and allowing the effective extension-retraction to occur in the shaft 38 linear movement and/or the telescoping of the shaft 40. It will also be recognized that the amount of telescoping which occurs in shaft 40 (assuming shafts 36 and 38 rotate about axes 42 and 46 respectively but shaft 38 is fixed linearly) is determined by the position of the wheel 60 which in turn is fixed by positioning the shaft 38.

From the foregoing, it will be realized by those familiar with the golf swing that, as the golfer properly executes the golf swing, a sequence of events occurs such that, if a flexible cord of fixed length were attached from the golf club to a fixed support displaced from the golfer, the cord (if it remains taut at all times) would be caused to become shorter to completion of the backswing and then be allowed to increase in length to its original length through impact and follow-through. This may better be illustrated and clarified by reference to FIGS. 7A, 7B and 7C. At FIG. 7A, the golfer is shown at address position. A flexible cord of fixed length 200 is affixed at one end thereof to the golf club 201 at a point 202 near the club head and at the other end thereof to a point 204 on a cone 206. The cone 206 is fixed, displaced from the golfer, on an axis 208 which intersects approximately the point where the golfer grips the golf club 201. FIG. 7B shows the golfer with the golf club 201 at the top of the back swing and is a view toward the left side of a right handed golfer (as in FIG. 7A). The original position of the cord and club are shown in phantom in FIG. 7B. As can be seen, the cord 200 has effectively shortened and would be slack at the top of the backswing but for the surface of the cone. With the cone, the flexible cord wraps around the surface thereof thus guiding the golf club to the proper position at the top of the back swing. FIG. 7C is a view taken toward the rear of a right-handed golfer with club and cord at the top of the backswing shown in phantom. It will also be recognized that as the golfer executes the downswing and follow-through, the cord 200 will effectively lengthen from the top of the backswing position to its full length a point just before, during and immediately after impact and then once again will effectively shorten. All the foregoing assumes the cord remains taut at all times.

The apparatus of the present invention may be adjusted or set as above described to accomplish the foregoing effective shortening and lengthening of the fixed-length cord. The various shafts of the apparatus of the present invention interconnected between the club and the support means function to provide the cord of fixed length and the conical surface as described above. As used throughout the specification and claims the term "effectively extensible shaft" is intended to encompass the shortening and lengthening of the cord, while retaining its taut condition, as above described. The term extensible is intended to include either construction.

Shown generally at 82 (FIG. 1) is a structure for use in assisting the golfer to maintain his head in a fixed position relative to the remainder of his body during the golf swing. The structure 82 includes a column 84 which is upwardly adjustable as is shown by the arrow 86. Extending outwardly from the column 84 is a trans-

verse member 88 which is adjustable along its axis as is shown by the arrow 90. A head-engaging member 92 is attached to the end of the transverse member 88 and includes a downwardly-extending section 94. The golfer may move his head downwardly or to the right but through the utilization of the head-engaging member 92-94, he will be precluded from moving his head upwardly or to the left (assuming the golfer is right-handed) during the swing. The column 84 is supported upon a base 96 or if the installation is permanent, it may be permanently installed.

Interconnected with each of the shafts 36, 38 and 40 is a motion-sensing apparatus as well as a power drive (actuating) apparatus. For clarity of illustration and ease of description, such apparatus has not been shown in detail with respect to each of the shafts. Referring however to FIGS. 3 and 4, there is illustrated exemplary apparatus which may be utilized in accordance with the present invention at each point needed in the device. As is shown for example in FIG. 3, linear motion along the axis of any of the shafts may be obtained by providing a hydraulic actuator having a cylinder 102 with a piston 104 reciprocally mounted therein. As fluid under pressure from a source 106 is applied, through a control device such as an electro-hydraulic servovalve 107 under control of electrical signals applied to the input 108, fluid flows into or out of the chambers 110 and 112 through the interconnecting lines 114 and 116, respectively. Such fluid motion causes the piston and the shafts 118 and 120 connected thereto to move reciprocally as indicated by the arrow 122. As the piston and the interconnecting shafts move, the position thereof may be indicated by a sensor and feedback element as is schematically illustrated at 124, the output signals therefrom being transmitted over the electrical leads 126 as position or feedback information for use in other apparatus. Such electrical feedback apparatus may take the form of a linear-motion potentiometer, a differential transformer, a variable-permeance transducer or the like.

Where rotary action is to be accomplished, such as is illustrated by the arrows 48, 54 and the like, a double-vane rotary actuator such as is illustrated in FIG. 4 may be utilized. As is therein shown, there is provided a housing 130 with a rotary vane 132 disposed therein. Openings 134 and 136 are provided to receive fluid, for example, as from the electro-hydraulic servovalve 107, as above described. As the fluid enters one of the openings such as at 134, it applies the force to the upper surface of the vane 138 and passes through the passageway 140 to apply force to the lower surface of the vane 142, thereby causing the vane to move in a counter-clockwise direction. As such movement occurs, fluid flows out of the opening 136. By the reversal of the fluid flow paths, the reverse motion of the vane will occur. Again, an appropriate transducer may be utilized for sensing the particular position of the vane and thus the position of the shaft attached thereto.

Apparatus of the type schematically illustrated in FIGS. 3 and 4 including the servovalves, the actuators, and the transducers are well known in the prior art and thus more detailed descriptions thereof will not be provided herein. For example, see the book *Electro-hydraulic Servomechanisms*, by Allen C. Morse, Library of Congress Catalog Card Number 63-15024, published 1963, by McGraw Hill Publishing Co., particularly chapters 3, 4 and 5 thereof.

A control system 150 may be interconnected through the utilization of a cable 152 with the swing-accommodating apparatus. The control system would be utilized for receiving information from the various sensors interconnected with the shafts and also for providing control signals to the actuators connected therewith for positioning the same. By reference to FIG. 2, a control system for example may be interconnected with the various sensors represented schematically at 154. The electrical signals would be carried over a cable 156 to an analog-to-digital converter 158. Such a converter is necessary since the signals developed by the various sensors are traditionally analog signals. The output of the analog-to-digital converter would be applied over the cable 161 as input signals to an electronic data-processing apparatus 162. The electronic data processor 162 may also receive input signals from other data sources such as is illustrated at 164 and may for example include signals from a programmer, a key-punch, a data terminal, or the like, as desired. The output from the electronic data processor may include numerical signals which would be applied over the cable 166 from the pre-programmed information obtained in the electronic data processor or alternatively may also include signals which would be applied over the cable 168 as a result of information from the other data sources as above mentioned. This numerical information would be applied to a digital-to-analog converter 170, the output of which would be applied over the cable 172 to the various power actuators represented schematically at 174 and which may take any desired form as above described.

The shaft 40 is adapted at its end 176 for connection to an instrument to be swung, for example, the golf club 160. Preferably the interconnection between the shaft 40 and the club 160 is such as to allow the club to rotate about its own axis. However, if the particular sport or swing within a sport is such that the instrument is to remain in a non-rotating mode through the swing, the attachment should preclude (or limit) such rotation. One form of such interconnection is shown in FIG. 6. The shaft 40 terminates in a yoke 180 having a pair of clamps 182-184 threadably received in arms 186-188 respectively thereof. The shafts 190-192 supporting the clamps are journaled for rotation in the arms 186-188. Thus, the club 160 may be held firmly in position by the clamps and at the same time be allowed to rotate as is evident.

When an individual is to utilize the machine constructed in accordance with the present invention for purposes of instruction in the swing of a golf club (for example only), he would first take his position upon the platform 98. Each of the shafts 36, 38 and 40 would be free to provide positioning relative to the particular size of the individual user. Upon being appropriately positioned, the linear position of the shaft 36 would be determined and the shaft would then be locked in place so that movement along the axis as illustrated by the arrow 44 would no longer occur. The shaft 38 likewise would be locked in position so that no further motion of a linear nature, as is illustrated by the arrow 50, could occur (assuming the use of a telescoping shaft 40). However, in all other fashion, the various shafts 36, 38 and 40 would be permitted to move fully. The power actuation would be removed from the system and all hydraulic chambers would be interconnected to provide no resistance to movements by the golfer. In

In addition thereto, each of the shafts would be counter-balanced so as to preclude the application of friction to the swing of the golfer insofar as such is possible. Under these circumstances, the golfer would then be requested to take a normal swing and strike several golf balls. In the process thereof, the outputs from the various sensors connected to the shafts **36**, **38** and **40** would detect all motions which may be imparted by the golfer to the golf club **160** as he performs the swing function. This information would be received by the electronic data processor **162** which may be programmed to provide a readout in the form of a curve, graph, chart or the like, showing the actions of the golfer as compared to some predetermined norm or standard swing.

Thereafter, if it is desired for the golfer to feel the movements of the club during a correct swing being performed, the power actuators could be activated with the electronic data processor through pre-programmed signals causing hydraulic fluid to be applied to each of the actuators as required to cause the golf club **160** to be swung in the desired fashion. Under these circumstances, the user would be a passive force merely holding onto the golf club and experiencing the sensation of a proper swing. Under these circumstances, the golfer may be taken through the motions of a proper swing several times so that he begins to get the correct feel herefor.

Thereafter, the apparatus may be utilized with a combination of the sensors and the power actuators being activated so that the golfer may then be required to take a normal swing and strike the golf ball. As such occurs, the motions imparted by the golfer to the golf club will be sensed by the sensors and applied to the electronic data processor. As the data processor receives the information, it will be compared against the norm or standards for the desired swing and signals may then be applied to the power actuators from the electronic data processor to make corrections in errors being committed by the golfer. The golfer would thus be caused during the process of taking a swing to make corrections so that the swing is properly executed.

During the swinging by the golfer, the various shafts may be fixed so as to preclude movement thereof in a given position for purposes of demonstrating a particular portion of the swing, as may be desired. For example, as the shaft **40** is effectively reciprocated, as is illustrated by the arrow **80** (FIG. 5), such indicates changes in the wristcock or the plane of the swing of the golf club. The accommodation of such changes in the plane of the swing is one of the unique features of this apparatus as compared to prior art apparatus. As was previously pointed out, all prior art apparatus known to applicant causes the swing of the golf club to occur in a generally semi-circular arc about some fixed point. When utilizing apparatus constructed in accordance with the present invention, such a swing may be in fact accommodated but would be detected in that the lower portion **66** of the shaft **40** would not be caused to move during the swing with respect to the upper portion **68** thereof. However in the event the golfer at the top of the backswing then moved his weight toward the left and commenced the downswing in the traditional fashion to cause an inside-out swing to occur, the plane of the swing of the golf club is changed. Just beyond the point of impact, slightly after the club head is brought into the ball, the shaft **66** is re-

turned to its original position at address, thereby indicating the proper type of swing. To accommodate this aspect of the golf swing, the shaft **36** will rotate a few degrees causing the shaft **38** to move slightly to the golfer's right (assuming a right-handed golfer) at the beginning of the downswing. Such motion may be accomplished by a simple stop mechanism such as a detent, or the like, properly positioned or by properly programming the data-processing equipment. Such motion is accommodated by the apparatus in accordance with the present invention. Thus, all motions of the golfer including rotation of the wrists, hands and forearms as well as cocking of the wrists and the plane change may be accommodated, detected, and/or instructed, as such is desired.

It will become apparent to those skilled in the art that the same apparatus may be utilized for teaching other swings useful in sports other than golf. For example, the bracket **32** may be moved along the support member **10** to bring the intersection of the shafts **38** and **40** substantially over the head of the user. As opposed to a golf club **160** being attached to the end of the shaft **40**, there could be attached a baseball bat. The bat could then be swung in the traditional fashion with the extensible portion **66** of the shaft **40** being utilized to detect variances in the desired level swing and the wristcock. Similarly, the apparatus so adjusted could be utilized in the swing of a tennis racket or a cricket bat, or the like.

What is claimed is:

1. Swing-accommodating apparatus comprising:
 - a support means having a base member and being adjustably positioned to accommodate various swings and various users;
 - means for locking said support means in position after said support means has been properly positioned;
 - swing-accommodator means activatable by a user of said apparatus for connection at one end to a device to be manipulated and at the opposite end thereof to said support means, said swing-accommodator means including:
 - a. means for adjustment thereof for definition of a reference about which a particular swing is to be performed, and
 - b. shaft means movable in unrestrained manner along the axis thereof and rotatable about the axis thereof simultaneously, and movable in an unrestrained manner in all planes relative to the axis thereof including planes orthogonal to each other thereby permitting full and free movement of said device by action of said user of said apparatus.
2. Swing-accommodating apparatus as defined in claim 1 wherein said shaft means includes a first shaft connected at one end thereof to said support means, a second shaft being extensible and retractable along its longitudinal axis and connected at one end thereof to said device, and a third shaft connected between the other end of said first shaft and the other end of said second shaft.
3. Swing-accommodating apparatus as defined in claim 2 which further includes means for locking a pre-selected one of said shafts in a predetermined position to preclude movement thereof thereby to assist in teaching a user of said apparatus by eliminating motions of said device normally permitted by said locked shaft.

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4. Swing-accommodating apparatus as defined in claim 2 wherein each of said shafts may be rotated about its axis and moved linearly thereof.

5. Swing-accommodating apparatus as defined in claim 4 wherein each of said shafts has transducer means for sensing movement thereof linearly and rotationally.

6. Swing-accommodating apparatus as defined in claim 5 wherein each of said shafts has actuator means for causing said shafts to move linearly and rotationally, and control means for imparting desired motion to said actuators.

7. Swing-accommodating apparatus as defined in claim 1 wherein said swing-accommodator means includes sensor means for producing output signals proportional to movement of said device.

8. Swing-accommodating apparatus as defined in claim 1 wherein said swing-accommodator means includes actuator means interconnected therewith to control movement of said device commensurate with input signals representative of a desired swing.

9. Swing-accommodating apparatus as defined in claim 1 wherein said shaft means includes sensor means for producing an output signal proportional to movement of said device; said shaft means including actuator means interconnected therewith to control movement of said device commensurate with input signals representative of a desired swing; and electronic data processor means interconnected to receive signals generated by said sensors and to generate signals for application to said actuators.

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