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(54) **Golf training diagnosing apparatus.**

(57) A cheap and safe golf training diagnosing apparatus (1) calculates and displays diagnostic information obtained from measured values of a shot ball (25). The apparatus is composed of an arm (20), one end of which is supported rotatably by a supporting member (21) and which has at least three shot detecting sensors (a, b, c) disposed at different positions on a measurement surface (23) at the other end thereof. The supporting member (21) is fixed to a plinth (28). A buffer member (25) transmitting a shot to the shot detecting sensors. A calculating unit (3) including a processing section calculates diagnosis information including at least a face angle of a golf club head, a swing path angle, a head speed of the golf club, a flight of a golf ball and a ball drive angle, starting from detection signals, which the shot detecting sensors obtain by detecting a shot transmitted from the buffer member. Diagnosis information is displayed visually. A cable (19) connects the shot measuring instrument, a power supply (9) and the processing section with each other.

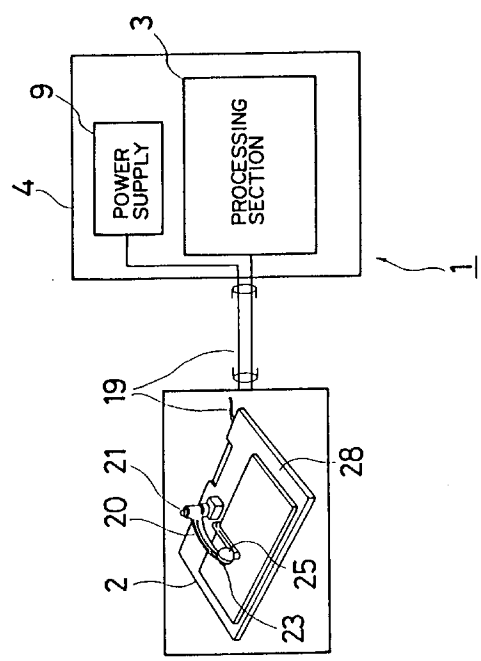

FIG.1

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FIELD OF THE INVENTION

The present invention relates to a golf training diagnosing apparatus, and in particular to a golf training diagnosing apparatus and a measuring instrument used therefor, in which striking force applied by a swing of a golf club head, direction thereof, etc. are measured by means of a shot sensor and diagnosis information including the flight of a golf ball and the ball drive angle is calculated and displayed.

BACKGROUND OF THE INVENTION

Heretofore following golf training diagnosing apparatuses are known.

(1) Those used as home golf training apparatus, in which information on movement of a club head directly before impact is obtained by means of a magnetic sensor;

(2) Those used as business golf training apparatuses, in which in addition to the information on movement of a club head obtained by the home golf training apparatuses described above, information on a ball directly after impact is detected by means of an infrared ray sensor, calculated and displayed; and

(3) Those used as systems for detecting ball trajectory, in which an image of a golf course is projected to be displayed; a simulation play of a player is measured; and a flight trajectory of a ball is simulated by using conditions of the course and swing conditions of the player to be displayed.

Information on the movement of the club head for (1) and (2) described above is obtained by calculation by means of a microcomputer, starting from values of signals obtained by the fact that the club head acting as a magnetic body passes over four sensors incorporated in a sensor unit by a method, by which variations in magnetic resistance within a magnetic circuit are detected in the form of a coil voltage, when the magnetic body such as an iron club, etc. passes directly above the magnetic sensors, and the information thus obtained is displayed.

Further information on the ball in (2) stated above is obtained from a detection position signal produced by disposing an infrared ray generating section and a group of photosensitive elements at a position opposite to the ball through the flight trajectory thereof and by detecting variations in characteristics of the photosensitive elements due to the fact that the ball interrupts the infrared ray.

However, although the home golf training apparatus described in (1) can display information on movement of the club head directly before impact, it can neither calculate nor display the trajectory of the ball, etc. Further it has an inconvenience that no information on the movement can be obtained, unless the club head passes directly above the magnetic sensors. The business golf training apparatus has, in addition to the drawback of (1), a drawback that, since the area of the detection surface consisting of the infrared ray generating section and the group of photosensitive elements disposed at the position opposite to the ball through the flight trajectory thereof should be great and it is necessary to arrange the photosensitive elements with a high density in order to measure the position of the ball directly after impact with a high precision by using the infrared ray sensor, which increases the fabrication cost and the sale price, if the area of the detection surface is restricted, the measurement cannot be effected for some balls and on the contrary, if the detection surface is enlarged while decreasing the density of the photosensitive elements, the measurement becomes rough and measured values are less precise. Further, since an impact is given really to the ball to make it fly, a large area is necessary or protecting measures or protecting installations are necessary in order that nobody is exposed to danger by a flying ball. Therefore it has a drawback that cost is increased.

Further the simulation system for detecting the trajectory of the ball indicated in (3) is constructed as a leisure installation, in which apart from e.g. the calculation/display device used in (2), a VTR for checking swings, and an audio system for producing effect are unified. Since cost therefor is extremely high and a satisfactorily large space is necessary, it is not suitable as a diagnosing apparatus, which can be used usually for home use or with ease at a low cost by disposing a plurality thereof in parallel in a golf course, etc. for business.

OBJECT OF THE INVENTION

The present invention has been done in view of the drawbacks and the problematical points described above of the prior art apparatuses and the object thereof is to provide a cheap and safe golf training diagnosing apparatus, by which swing angles, measured values of a flying ball, etc. are obtained and which calculates and displays diagnosis information such as the measured values, evaluation of the measured values, the trajectory of the ball, etc.

SUMMARY OF THE INVENTION

In order to achieve the above object, a golf training diagnosing apparatus according to the present invention is characterized in that it comprises a shot detecting member incorporating at least one shot sensor and supported so as to be shot by a golf club and movably by this shot in a predetermined extent and calculating means connected electrically with the shot sensor in the member described above, which calculates at least a flight of a golf ball on the basis of a detection signal outputted by the shot sensor, responding to a shot by the golf club.

When the shot detecting member is shot by the golf club, detection signals from one or three sensors described above are sent to the calculating means. The calculating means calculates the flight of the golf ball or a ball drive angle on the basis of these detection signals.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a schematical diagram representing an embodiment of the golf training diagnosing apparatus according to the present invention;
Fig. 2A is an enlarged diagram of an arm section indicated in Fig. 1;
Fig. 2B is a cross-sectional view along a line X-X' in Fig. 2A;
Fig. 3 is a block diagram showing an example of construction of a processing section in Fig. 1;
Fig. 4 is a flow chart showing the operation of the golf training diagnosing apparatus of the present embodiment;
Fig. 5 is a timing chart for PIO bit control;
Fig. 6 shows an example of waveforms of the output voltage of different shot sensors at a shot;
Fig. 7 is a diagram for explanation showing a holding period of a peak voltage;
Fig. 8 shows peak hold circuits and time difference detecting circuits combined therewith;
Fig. 9 is a diagram for explaining a difference between count values in the time difference detecting circuit;
Fig. 10 shows an experimental example of voltage waveforms produced by a driver shot and a stroke by a putter;
Fig. 11 is a block diagram showing the construction of an example of application of the golf training diagnosing apparatus according to the present invention;
Fig. 12 shows an example of format for a shot diagnosis image;
Fig. 13 shows an example of format for a shot diagnosis result image;
Fig. 14 shows an example of format for a shot training image;
Fig. 15 shows an example of format for a shot training result image;
Fig. 16 shows an example of format for a putt training image;
Fig. 17 shows an example of format for a stroke play image;
Fig. 18 is a perspective view indicating a buffer member and an arm supporting member;
Fig. 19A is a cross-sectional view indicating the construction of the supporting member with a tee.
Fig. 19B is a cross-sectional view indicating the construction of the supporting member without tee;
Fig. 20 is a diagram indicating how to change the height of the supporting member;
Figs. 21A and 21B show a stopper member, indicating the supporting member at the initial state and at the position, where the stopper begins to work, respectively;
Fig. 22 is a perspective view indicating a modified example of the shot measuring instrument; and
Fig. 23 is a diagram indicating the modified example of the shot measuring instrument more in detail.

DETAILED DESCRIPTION

Fig. 1 is a schematical diagram of an embodiment of the golf training diagnosing apparatus according to the present invention, in which reference numeral 1 is a golf training diagnosing apparatus; 2 is a shot measuring instrument; 3 is a processing section; 4 is a unit; 9 is a power supply; 19 is a cable connecting the shot measuring instrument 2 with the unit 4; 20 is an arm; 21 is a supporting member supporting the arm 20; 23 is a measurement surface, which is a free end of the arm and on which three shot sensors a, b, and c are disposed; and 25 is a buffer member. The cable 19 includes a power supplying cable.

In Fig. 1, the golf training diagnosing apparatus 1 is composed of the shot measuring instrument 2 consisting of the arm 20, one end of which is supported rotatably by the supporting member 21 and which has at least three shot detecting sensors a, b and c disposed at different positions on the measurement surface 23 at the other end and a plinth 28 for fixing a supporting member 21 supporting the arm, the buffer member 25 transmitting a shot given by a golf club head 29 (cf. Fig. 2) to the shot detecting sensors a, b and c; calculating means connected electrically with the shot detecting sensors a, b and c and calculating diagnosis information including at least the face angle of the golf club head 29, the swing path angle, the head speed of the golf club, the flight of the golf ball and the ball drive angle, starting from inputted detection signals obtained by detecting a shot by the golf club head 29 transmitted by the buffer member 25; the unit 4 including the processing section 3 having display means displaying visually the diagnosis information after calculation and the power supply 9; and the cable 19 connecting the shot measuring instrument 2, the power supply 9 and the processing section with each other.

Figs. 2A and 2B are enlarged diagrams of the arm indicated in Fig. 1, Fig. 2A being an enlarged diagram of the arm 20 viewed directly from above, Fig. 2B being a cross-sectional view thereof along an X-X' line in Fig. 2A. In Fig. 2A, 22 is a shot position detecting switch and 26 represents a shot position.

One end of the arm 20 is supported rotatably by the supporting member 21 and a shaft 22 and the three shot detecting sensors a, b and c consisting of piezoelectric elements are implanted with a constant interval at different positions on the measurement surface indicated by the X-X' line at the other end (end portion on the sensor side), as indicated in Fig. 2B. Although piezoelectric elements are used for the shot sensors in the present embodiment, they are not restricted thereto, but e.g. magnetic sensors may be used therefor.

In order to prevent destruction of the sensors a, b and c by the shot, the buffer member 25 is fitted to the measurement surface. The buffer member 25 is made of a material having durability and elasticity, e.g. plastic material, which is subjected directly to a shot of the club head 29 by swing of the golf club and transmits the force and the direction thereof to the shot sensors a, b and c. The end portion 23 on the sensor side of the arm is normally at the shot position 26 and rotated by a shot by the club head 29 (in the embodiment it is rotated clockwise, but it is not restricted thereto). When it is rotated by 270°, it is suppressed by a stopper 27 and returned again to the shot position.

Fig. 3 is a block diagram indicating an example of construction of the processing section 3. In Fig. 3, reference numeral 30 is a CPU acting as the calculating means and a control section; 31 is an operation panel, on which operation buttons, switches, etc. (not indicated in the figure) are mounted; 32 is an input stage, through which data from a time difference detecting circuit (stated later) are inputted; 33 is an input stage, through which data from a peak hold circuit (stated later) are inputted; 34 is a PROM, in which a procedure (program means) for executing various operations of the present diagnosing apparatus is stored; 35 is an RAM serving as an interval memory; and 36 is a CRT acting as display means.

When the diagnosing apparatus 1 is started, after the CPU 30 has terminated its initial setting operation, it reads out the program means stored in the PROM one after another. In this case, data inputted through the input stages 31 and 32 are stored in the RAM 35; diagnosis information is calculated according to a predetermined calculation method (stated later); and information to be displayed is outputted by the program means described above to the CRT 36 in a predetermined format (stated later).

1. <Diagnosis principle of the golf training diagnosing apparatus>

The CPU 30 calculates various diagnosis information by using following relationships on the basis of output voltages (waveforms) from the shot sensors a, b and c.

[Relation between the diagnosis item and the output waveform]

Denoting the waveform of the output voltage of the sensor a by x1, the waveform of the output voltage of the sensor b by x2, and the waveform of the output voltage of the sensor c by x3, following items are represented as follows:

(1) face angle of the club: $\alpha=f(x1, x2, x3)$
(2) swing path angle of the club: $\beta=f(x1, x2, x3)$
(3) head speed of the club: $V=f(x1, x2, x3)$
(4) flight of the ball: $L=f(x1, x2, x3)$
(5) ball drive angle (horizontal): $\Theta_1=f(x1, x2, x3)$
(6) ball drive angle (vertical): $\Theta_2=f(x1, x2, x3)$

[Example of diagnosis principle; approximation formula]

Denoting the peak voltage value by E and the time from the rise of the waveform to the time where the peak voltage value appears by T in the output waveform x1, x2 and x3, experiments were repeated on the output of the shot sensor a; E_A and time T_A, the output of the shot sensor b; E_B and time T_B, and the output of the shot sensor c; E_C and time T_C and it was found that following approximation formulas are valid, if the position and the direction of the sensors a, b and c are suitably selected.

(i) face angle of the club: $\alpha=k1(T_A-T_B)$
(ii) swing path angle of the club: $\beta=k1(T_A-T_B)+k2(E_A-E_B)$
(iii) head speed of the club: $V=k3(E_A+E_B+E_C)$
(iv) flight of the ball: $L=k4(E_A+E_B+E_C)$
(v) ball drive angle (horizontal); $\Theta_1 =k5(T_A-T_B)+k6(E_A-E_B)$
(vi) ball drive angle (vertical): $\Theta_2 =k6((T_A-T_B)/(2-T_C))$ where k1 to k6 are constants.

2. <Operation of the golf training diagnosing apparatus>

Fig. 4 is a flow chart indicating the operation of the golf training diagnosing apparatus 1 according to the present embodiment.

Hereinbelow the operation of the shot measuring instrument 2 will be described, referring to Fig. 4.

[Steps 41 to 43] Initial operation

After the initial setting (Step 41), it is judged whether the mode is self-diagnostic or not (Step 42). In the case where the mode is self-diagnostic, a flag is set for transmitting six input channels for the output of the shot sensor a; E_A and time T_A, the output of the shot sensor b; E_B and time T_B, and the output of the shot sensor c; E_C and time T_C, as well as the value of the voltage converting counter and the time difference calculation value to the CPU 30 (Step 43) to execute Step 44. In the case where the mode is not self-diagnostic, Step 44 is executed directly.

[Steps 44 to 46] Test of the shot position detection switch

When the end portion 23 of the arm 20 is set at the shot position 26, the shot position detection switch 22 emits a signal "H". Then it is judged whether the signal is "H" or not. In the case where it is not "H", the procedure enters a loop, where the end portion 23 of the arm 20 waits to be set at the shot position 26. On the contrary, in the case where the signal is "H", in order to confirm again after about 100ms whether the end portion 23 is really at the shot position, it is judged whether the signal is "H" or not. In the case where the signal is not "H", the procedure enters a loop, where the end portion 23 of the arm 20 waits to be set at the shot position 26, and in the case where the signal is "H", Step 47 is executed.

[Steps 47 to 48] Notice of shot preparation to the processing section 3

When the signal "H" of the shot position detection switch 22 is confirmed, after PIO bit control as indicated in the timing chart in Fig. 5 has been effected, a state signal Ready is transmitted as a notice of shot preparation. The processing section 3, which has received the state signal Ready, displays the Ready on the display section 36. In this way, even if there is any shock, when the arm is returned to the shot position after the ball has been impacted with the club head 29, the processing section 3 can recognize owing to the shot position detection switch whether it is the signal due to the shot or not.

[Step 50] Detection of shot and WAIT

When the golf club is swung to give impact (shot) with the club head 29 to the buffer member 25 fitted to the end portion 23 of the arm 20, the piezoelectric elements a, b and c disposed at three positions on the measurement surface output voltages depending on the magnitude and the direction of the shot with some time differences.

In this case, WAIT is a time constant necessary for stopping the detecting circuit (cf. Fig. 8) before the arm 20 is locked at the stopper position, when the piezoelectric elements a, b and c sense the shock given by the club head 29. In other words, since the shock at the lock, when the arm 20 rotated around the shaft 22 by the shot is locked at the stopper position, is the greatest next to that produced at the shot, measurement errors are great, if the shock is detected by the detecting circuit, and therefore measurement at the shot is difficult, a predetermined part of the period of time from the shot to the lock is set as WAIT. The operation of the detecting circuit is interrupted in the lapse of the WAIT.

[Steps 51 to 53] Reading out and transmission of the peak hold value and the time difference

After the WAIT, after having made a count disable/peak input disabling bit in the PIO bit "L", information for six channels coming from the sensors a, b and c and held by hard logic in the input stages 31 and 32 is read out at a stretch and the peak values thereof are inputted to the A/D converter 85 (Fig. 8), where they are converted into digital values, which are transmitted to the CPU 30 through a bus 95. On the other hand, the time differences are transmitted to the CPU 30 through the bus 95.

3. <Input circuit of diagnosis information>

Fig. 6 shows waveforms of the output voltages from the different shot sensors at the shot. In Fig. 6, Va, Vb and Vc represent peak voltages of the piezoelectric elements a, b and c, respectively, and t_a, t_b and t_c represent peak delay times therefor.

Further Fig. 7 shows peak voltage hold times for the piezoelectric elements a, b and c. The peak voltages of the shot are deferred in several seconds indicated by t_a, t_b and t_c in Fig. 6 after the shot by the club head 29 by peak hold circuits as indicated in Fig. 8. In this way there is marginal time for converting a plurality of analogue signals into digital signals by means of an A/D converter while switching over them.

Fig. 8 shows peak hold circuits and time difference detecting circuits combined with the peak hold circuits, in which reference numerals 81 and 82 are peak hold circuits acting as the first input stage 31; 83 is an attenuator, which attenuates the voltage to 1/n; 84 is a switch; 85 is an A/D converter; 91 and 92 are time difference detecting circuits acting as the second input stage 32; 93 and 94 are counters; and 95 is a bus.

In Fig. 8, voltages inputted from the piezoelectric elements a, b and c are bifurcated into two. The voltage inputted to the peak hold circuit 81 is attenuated by the attenuator 83 so that the peak hold circuit 81 acts as a low sensitivity peak hold circuit.

Further a plurality of analogue signals represented by peak voltages held by the peak hold circuits are converted into digital signals, while switching them by means of the switch 84, which digital signals are outputted to the bus 95.

The respective signals (voltages) are inputted from the peak hold circuits 81 and 82 to the time difference detecting circuits 91 and 92 as indicated in Fig. 8. In the case where the peak hold circuit 81 side is read, the time difference detecting circuit 91 side is read, while in the case where the peak hold circuit 82 side is read, the time difference detecting circuit 92 side is read. The counters 93 and 94 count the magnitudes of the respective voltage values as indicated in Fig. 9. The counting is stopped at a point of time, where the count values are constant (minimum). Differences of the count are obtained by subtracting the minimum count values from the maximum count values. On the other hand, since a period of time corresponding to one count is known previously, the time differences can be obtained by dividing the count numbers by the count times.

Fig. 10 shows an experimental example on the waveform produced by a driver shot and a knock by a putter. According to the experiment, if the voltage level inputted to the A/D converter 85 was set so that it could be read out as a digital value to the bus 95, DF was increased as indicated in Fig. 10. Next at the knock by the putter, although a voltage appeared to be low, OO was increased as indicated in Fig. 10. On the contrary, if the voltage level is set so that the voltage due to the knock by the putter is read out, the signal is saturated, independently from whether the buffer member is shot strongly or weakly by the driver, the signal is increased only to FF. In other words, it was understood that there is a great difference in the dynamic range.

Therefore there were disposed two peak hold circuits 81 and 82 having different sensitivities as the pair 80 of peak hold circuits enclosed by a broken line in Fig. 8 and the outputs thereof were switched by the switch 84 to be inputted to the A/D converter 85. As the result it was possible to read out the output of the peak hold circuit 81 in the case of the driver shot, but not possible to read out the output of the peak hold circuit 82. In the case of the shot by the putter, although it was possible to read out the output of the peak hold circuit 82, it was not possible to read out the output of the peak hold circuit 81. In other words, since either one of the pair 80 of the peak hold circuits can be read out in the case of the driver shot or the shot by the putter, the dynamic range of the A/D converter 95 is enlarged equivalently by a factor n.

4. <Example of application (example of display of diagnosis results)>

Fig. 11 is a block diagram indicating the construction of an example of application of the golf training diagnosis apparatus according to the present invention. In Fig. 11, each block 110 to 167 is constructed by program means. These program means are stored in program storing means (e.g. PROM) in the processing section as indicated in Fig. 3 and executed one after another by the CPU at the start of the golf training diagnosing apparatus. The present example of application will be explained by using the construction of the golf training diagnosing apparatus 1 described previously.

[Step 110] Display of title and menu

When the golf training diagnosing apparatus 1 is started, the title and the menu indicating Steps 130, 140, 150, 160 and "end" are displayed on the screen of the CRT 36. [Step 120] Menu selection

A user selects a menu by using function keys (or a keyboard, buttons, etc.) on an input panel 31.

[Step 130] Shot diagnosis

In order to examine or compare characteristics, etc. of clubs, results of each shot are displayed on the CRT 36, using a format as indicated in Fig. 12 or 13.

[Steps 131 and 132]

External input data such as name of trainee, used club, etc. are inputted by using a keyboard (or OCR, etc.) on the input panel 31.

[Step 133] Shot diagnosis

The CPU 30 obtains inputted information by the operation (cf. 2. <Operation of the golf training diagnosing apparatus>) indicated in Fig. 4 described previously by the fact that the trainee shoots the end portion 23 of the arm 20 in the shot measuring instrument; calculates the face angle of the club, the swing path angle of the club, the head speed of the club, the flight of the ball, the ball drive angle (horizontal), the ball drive angle (vertical), etc. as well as the trajectory of the ball as diagnosis information by the principle described previously (cf. 1. <Diagnosis principle of the golf training diagnosing apparatus>) on the basis of the inputted information; and displays them on the CRT 36 in a format as indicated in Fig. 12. Further the shot diagnosis can be effected repeatedly. In addition, it can be effected by calling Step 134 by means of function keys on the operation panel 31. When the shot diagnosis is terminated, the procedure returns to Step 120 and a new menu is selected.

When the square in the left lower part of the image indicated in Fig. 12 shows "READY", the trainee can shoot. On the contrary, when it shows "BALL PREPARATION", the end portion 23 of the arm 20 is returned to the shot position 26 to make the state "READY". In addition, the ball is moved and displayed while leaving a trajectory of the ball. When the ball stops, the numerical value is displayed in the lower part of the screen. If the flight is below 150 yards, no ball drive angle is displayed.

[Step 134] Display of shot diagnosis results

Shot diagnosis results are appropriately displayed by Step 12. They are displayed in the form of a list in the format indicated in Fig. 13 and the procedure returns to Step 133. The display of the results can be viewed while moving forward or backward information on the screen by stroke manipulation.

[Step 140] Shot training

In order to know or compare results of the golf training, results of each shot are displayed on the CRT 36 in the form indicated in Figs. 14 and 15.

[Steps 141 and 142]

External input data such as name of trainee, used club, etc. are inputted by using a keyboard on the input panel 31.

[Step 143] Display of shot training results

The CPU 30 obtains inputted information by the operation indicated in Fig. 4 described previously by the fact that the trainee shoots the end portion 23 of the arm 20, calculates the face angle of the club, the swing path angle of the club, the head speed of the club, the flight of the ball, the ball drive angle (horizontal), the drive angle (vertical), etc. as well as the trajectory of the ball as diagnosis information by the principle described previously on the basis of the inputted information; and displays them on the CRT 36 in a format as indicated in Fig. 12. Further the shot diagnosis can be effected repeatedly. In addition, it can be effected by calling Step 144 by means of function keys on the operation panel 31. When the shot training is terminated, the procedure returns to Step 120 and a new manu is selected.

When the square in the left lower part of the image indicated in Fig. 14 shows "READY", the trainee can shoot. On the contrary, when it shows "BALL PREPARATION", the end portion 23 of the arm 20 is returned to the shot position 26 to make the state "READY". In addition, the ball is moved and displayed while leaving a trajectory of the ball. When the ball stops, the numerical value on the screen is displayed. If the flight is below 150 yards, no ball drive angle is displayed.

[Step 144] Summation and display of shot diagnosis results

Shot diagnosis results are summed and appropriately displayed by Step 14. They are displayed in the form of a list in the format indicated in Fig. 15 and the procedure returns to Step 143.

[Step 150] Putt training

In order to know results of the shot training, results of each shot are displayed on the CRT 36 in the form indicated in Fig. 15.

[Step 151] Display of putt training results

The CPU 30 obtains inputted information by the operation indicated in Fig. 4 described previously by the fact that the trainee shoots the end portion 23 of the arm 20, calculates the length of movement of the ball, transversal deviations, etc. by the principle described previously on the basis of the inputted information; and displays them on the CRT 36 in a format as indicated in Fig. 16. Further the putt training can be effected repeatedly. When the putt training is terminated, the procedure returns to Step 120 and a new menu is selected.

[Step 160] Stroke play

A simulation course as indicated in Fig. 17 is displayed on the CRT 36 and an image of the ball is advanced for every stroke. Results of the shot or the putt and whereabouts of the ball are examined and marks are given them. Results of every stroke are displayed on the CRT 36 in a format indicated in Fig. 17.

[Step 161] Restart of stroke play

In the case where the trainee wishes to restart an interrupted stroke play, he pushes function keys on the input panel 31 to execute Step 165.

[Steps 162 and 163]

External input data such as name of trainee, used club, etc. are inputted by a keyboard, an OCR, etc. on the input panel 31.

[Step 164] Selection of form of play

The form of play is selected by using function keys or a keyboard on the input panel 31.

[Step 165] Stroke play

The CPU 30 obtains inputted information by the operation indicated in Fig. 4 described previously by the fact that the trainee shoots the end portion 23 of the arm 20; calculates the face angle of the club, the swing path angle of the club, the head speed of the club, the flight of the ball, the ball drive angle (horizontal), the ball drive angle (vertical), etc. as well as the trajectory of the ball as diagnosis information; and displays the position of the ball on the course in the format as indicated in Fig. 17 on the CRT 36. In the stroke play, when the trainee has made a round in all the courses, Step 167 is executed and when the play is interrupted at a hole on the way, the position of the ball, scores and other calculated values upto that point are stored at Step 166. Then the procedure returns to Step 120 and a new menu is selected.

[Step 167] Disposition at hole-out

The trajectory of the ball in all the courses, the flight for every course, calculated values, scores and the sum of scores, etc. are displayed. After the termination of the display, the procedure returns to Step 120 and a new menu is selected.

Although an embodiment and an example of application of the present invention have been explained in the above, the present invention is not restricted to the embodiment described above and it is a matter of course that various modified executions are possible.

Further in the shot measuring instrument 2, the buffer member 25 is nearly a half of a golf ball, i.e. it is approximately hemi-spherical, as indicated in Fig. 18, and mounted detachably on the end portion 23. The cable 19 from the different sensors a, b and c passes through the groove 20a in the arm 20 and the supporting member 21 to arrive at the processing section 3.

The supporting member 21 is so constructed that its height can be varied, depending on whether it is a tee-shot or not, as indicated in Figs. 19A and 19B. In the figure, the supporting member 21 consists of a cap member 21a and a pillar 21b and the arm 20 described above, etc. are mounted on the cap member 21a and the pillar 21b is inserted therein so that the cap member 21a is rotatable and dismountable. Two grooves 21c and 21d having different heights are formed in the pillar 21b and on the other hand a screw 21e is screwed in the cap member 21b.

The change in the height is effected by changing the groove 21c or 21d, with which the screw 21e is engaged. The grooves 21c and 21d described above are formed so that change in the arm height can be effected at an angle within an extent of 30°, as indicated in Fig. 20.

Further, as indicated in Figs. 21A and 21B, a first stopper member 21f is disposed in the neighborhood of the supporting member 21 and a second stopper member 21g is disposed in a part of the outer periphery of the cap member 21a.

When the arm 20 is rotated in the direction indicated by an arrow by about 90°, the first and the second stopper member begin to be engaged with each other to brake the arm and they are so constructed that braking force increases with increasing rotation angle over 90°. In this way it is possible to prevent unnecessary rotation of the arm 20.

A matter of primary concern as golf diagnosing information is the flight of the golf ball. In the case where it is desired to know only the flight, one sensor may be sufficient.

Further the buffer member is not necessarily dismountable from the arm. For example, they may be formed in one body, in which the sensors are incorporated. Instead of the arm the member stated above may be bound only with strings, etc.

Figs. 22 and 23 show a modified example of the shot measuring instrument, in which 30 represents a buffer member formed detachably (or in one body) at one end of an arm 31 and the other end of the arm 31 is mounted rotatably on an horizontal bar 33 supported by a supporter 32.

Three shot sensors 34 to 36 are mounted on the back surface of the one end of the arm 31 stated above. 37 is a print board disposed on the back surface of the arm 31. One end of each of conductor lines 38 formed on the print board is connected with each of the sensors and the other end thereof is connected with a contact plate 39.

Each of contact plate 39 is contacted slidably with each of the terminal plates 40 and lead wires 41 from different terminal plates 40 are connected with the unit described previously.

The method for calculating diagnosis information in the processing section according to the present invention is not restricted to the approximation formulas described previously. Instead thereof, necessary tables are prepared previously on the basis of various experimental data on the detection signals from the sensors and the flight, etc. and more precise diagnosis information may be obtained on the basis thereof or on the basis of the approximation formulas together therewith.

As explained above, according to the present invention, since the shot by the golf club head is transmitted to the shot sensors through the buffer member and the calculating means calculates diagnosis information including at least the face angle of the golf club head, the swing path angle, the head speed of the golf club, the flight of the golf ball, and the ball drive angles from detection signals from the different shot sensors, and displays the diagnosis information by the display means, it is possible to obtain the swing angle, measured values on the shot ball, etc. and to calculate and display diagnosis information such as these measured values, evaluation of the measured values, the trajectory of the ball, etc. Further, since it requires no large space, an apparatus, which can be installed easily and is cheap, is provided. In addition, since no ball flies really, it is safe.

The term "flight" used in the specification refers to the total linear displacement of the ball for a given simulated trajectory.

Claims

1. A golf training diagnosing apparatus (1) comprising a shot detecting member (25), detection means operable to produce detection signals responsive in use to movement of the shot detecting member responsive to being shot by a golf club (29) and calculating means (3) responsive to the detecting signals to calculate at least a flight of a corresponding simulated golf ball trajectory characterised in that the detection means comprises one or more shot sensors (a, b, c) incorporated in the shot detecting member, the shot detecting member being supported so as to be movable by a predetermined extent when shot by the golf club and in that the calculating means is connected electrically with the one or more shot sensors.

2. A golf training diagnosing apparatus as claimed in claim 1 wherein the detection means comprises three or more shot sensors (a, b, c) and the calculating means is further operable to calculate a ball drive angle of the simulated golf ball trajectory.

3. A golf training diagnosing apparatus according to claim 2, wherein said shot detecting member comprises:

   an arm (20), one end of which is supported rotatably and which has at least three shot sensors (a, b, c) disposed at different positions on another end thereof; and

   a buffer member (25), which transmits the shot by the golf club to the different shot sensors.

4. A golf training diagnosing apparatus according to claim 3, wherein said buffer member has a predetermined elasticity and it is formed detachably on the other end of said arm.

5. A golf training diagnosing apparatus according to claim 1, further comprising display means (36) for displaying diagnosis information obtained by said calculating means.

6. A golf training diagnosing apparatus according to claim 3, where said arm is constructed so as to be regulable in at least two different heights.

7. A golf training diagnosing apparatus according to claim 2, further comprising a stopper member (27) restricting the rotation angle of said arm to a predetermined extent.

FIG.1

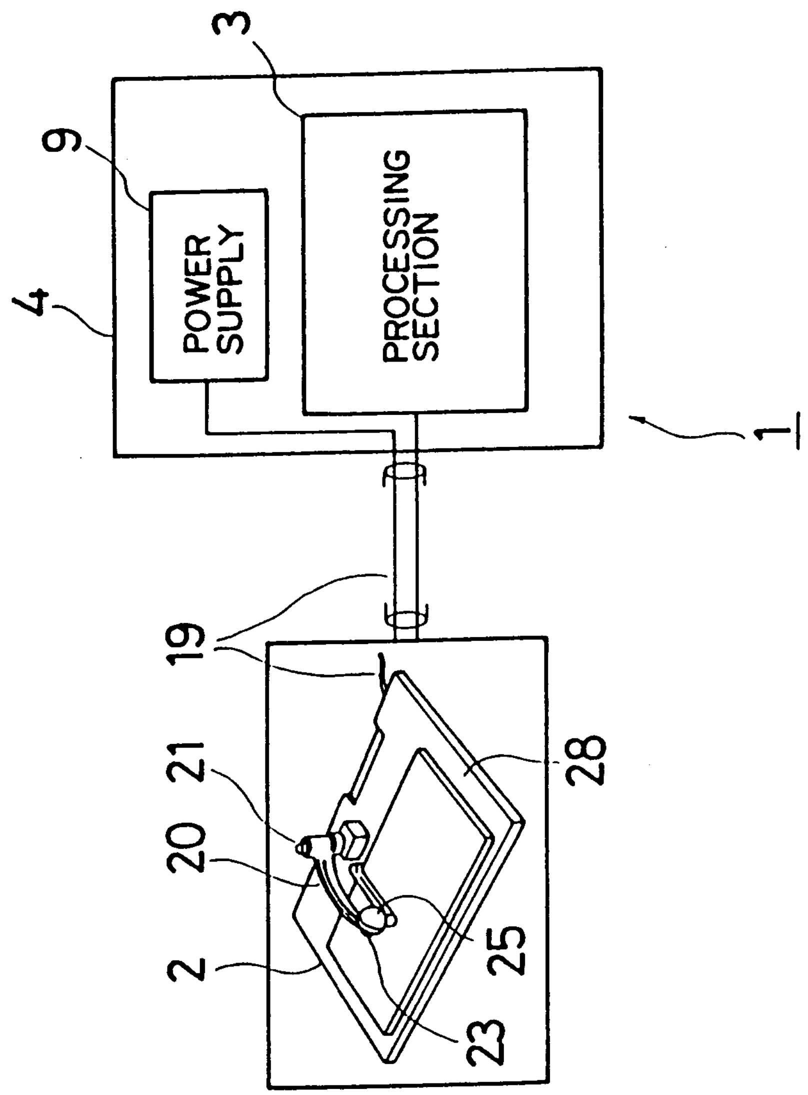


FIG.2A

(A)

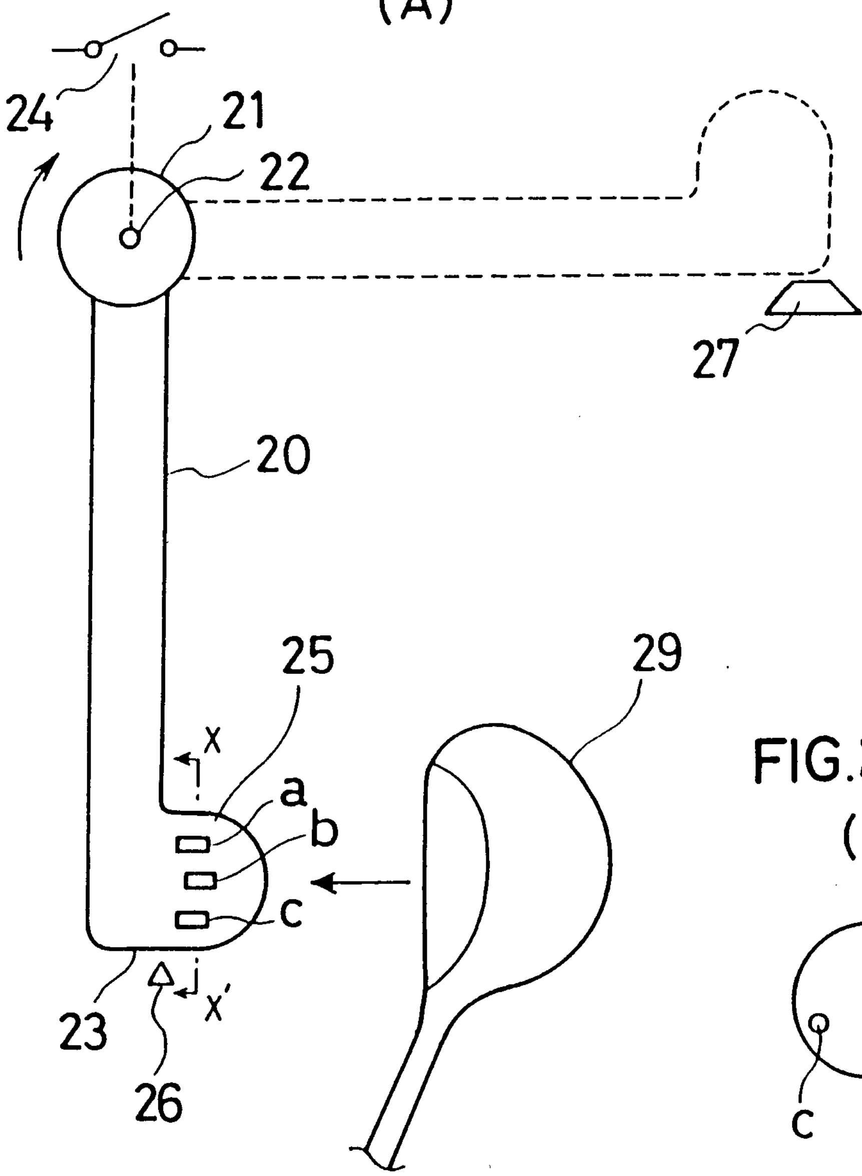


FIG.2B

(B)

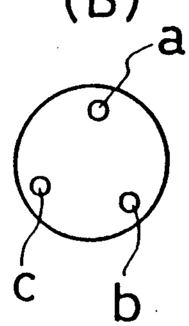


FIG.3

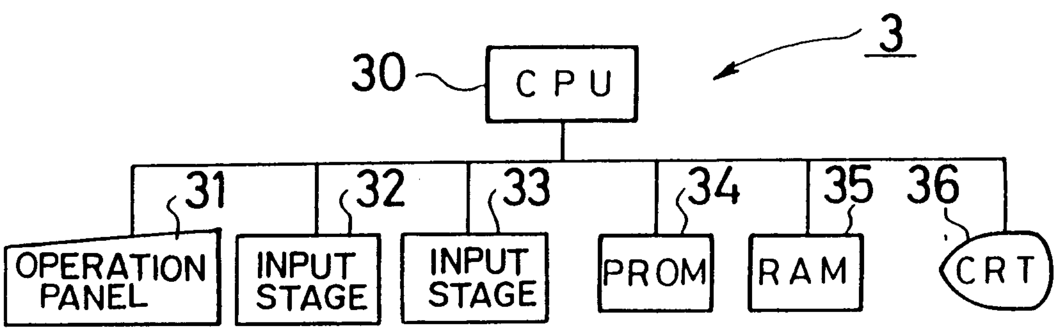


FIG. 4

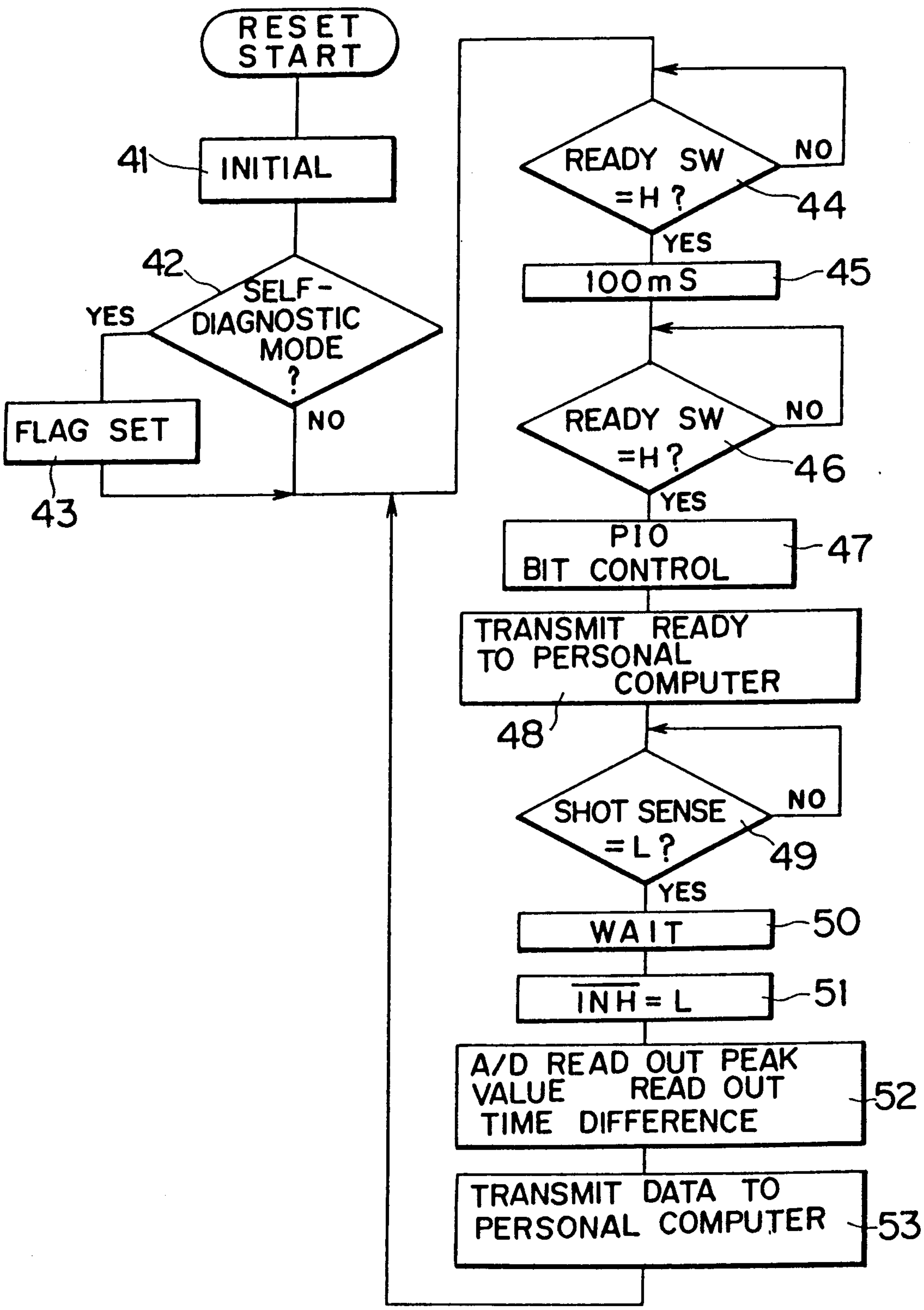

RESET START
41
INITIAL
42
SELF-DIAGNOSTIC MODE ?
YES
NO
FLAG SET
43
READY SW =H ?
NO
44
YES
100mS
45
READY SW =H ?
NO
46
YES
PIO BIT CONTROL
47
TRANSMIT READY TO PERSONAL COMPUTER
48
SHOT SENSE =L ?
NO
49
YES
WAIT
50
$\overline{INH}$ = L
51
A/D READ OUT PEAK VALUE READ OUT TIME DIFFERENCE
52
TRANSMIT DATA TO PERSONAL COMPUTER
53

FIG. 5

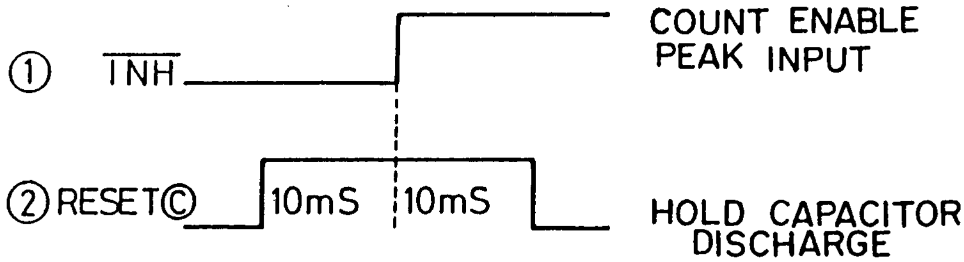

① $\overline{INH}$
COUNT ENABLE
PEAK INPUT
② RESET©
10mS
10mS
HOLD CAPACITOR
DISCHARGE

FIG. 6

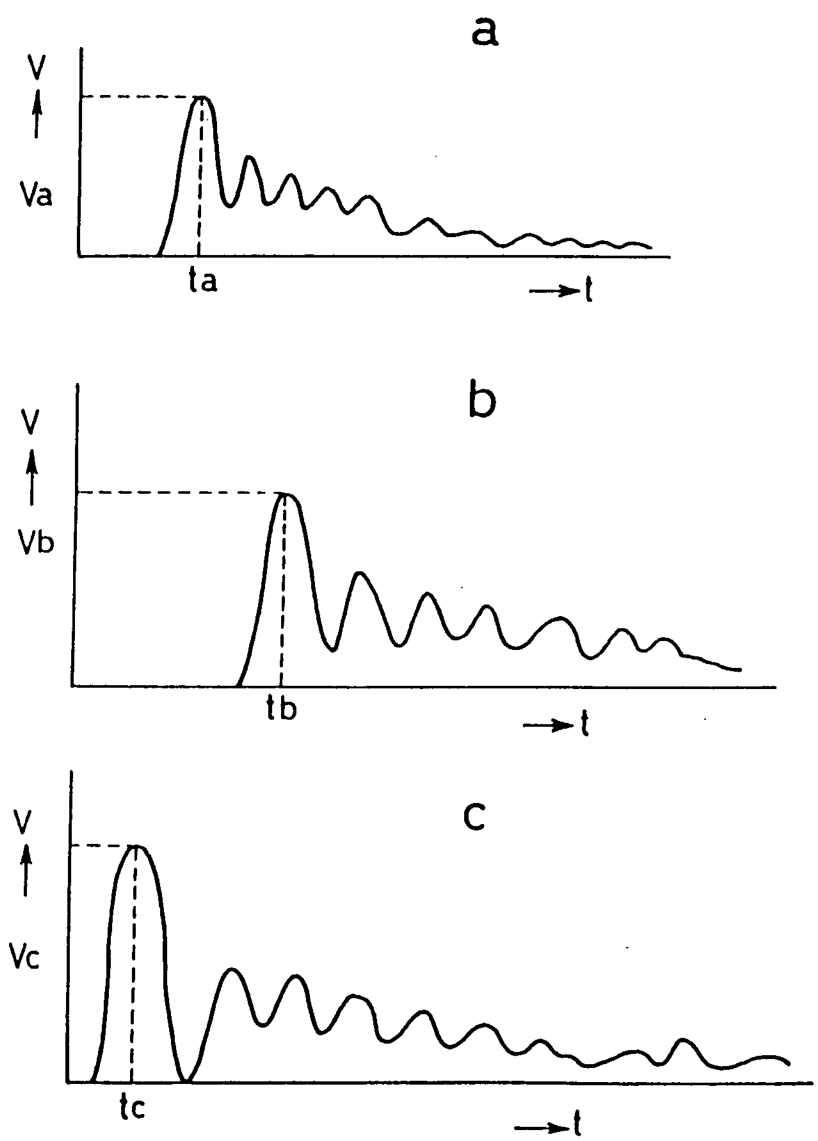

a
V
Va
ta
t
b
V
Vb
tb
t
c
V
Vc
tc
t

FIG.7

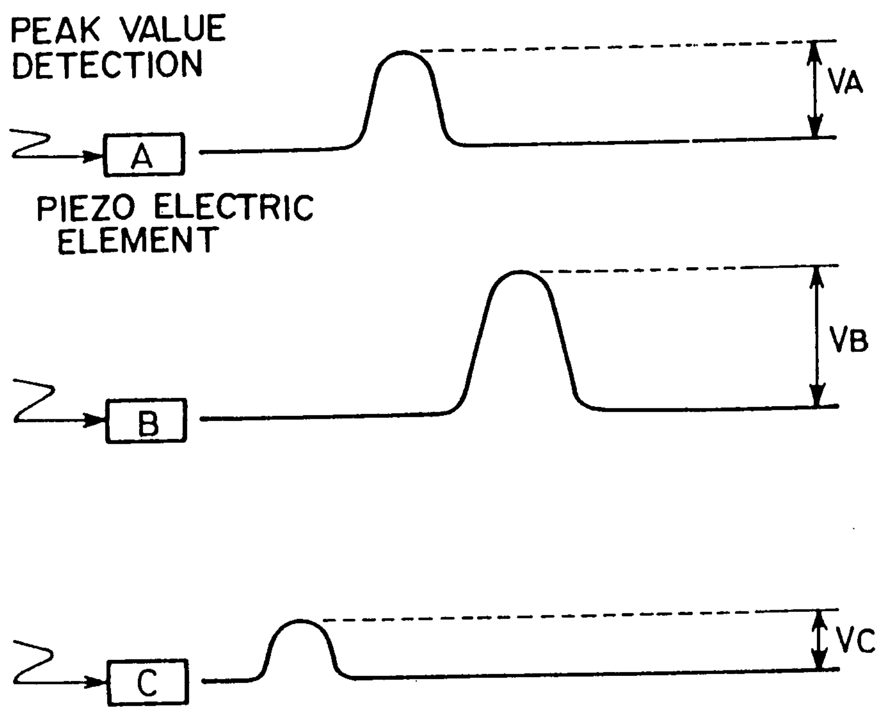


FIG. 8

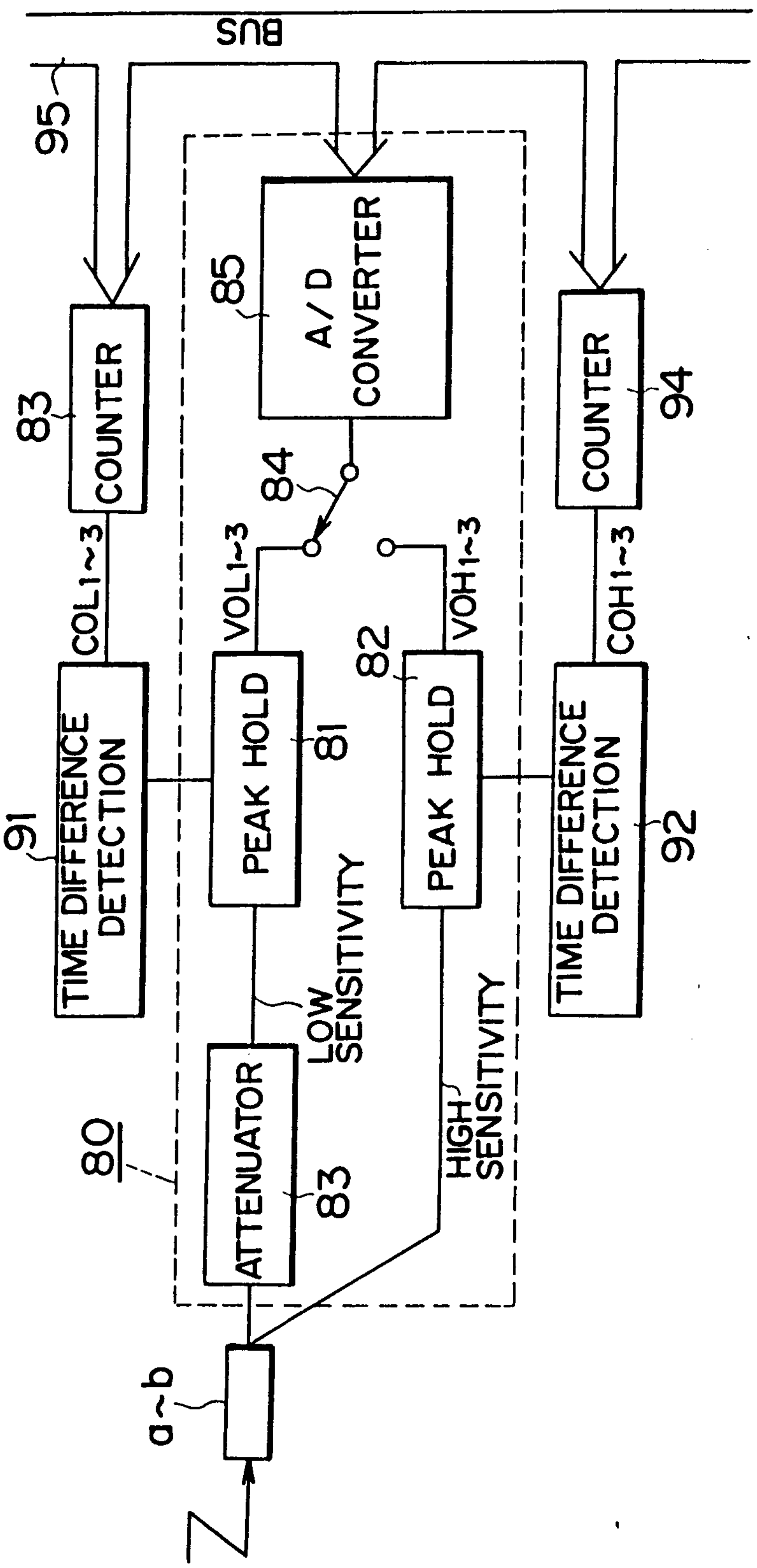

BUS
95
83
COUNTER
85
A / D
CONVERTER
COUNTER
94
84
COL1~3
VOL1~3
VOH1~3
COH1~3
91
TIME DIFFERENCE
DETECTION
PEAK HOLD
81
82
PEAK HOLD
TIME DIFFERENCE
DETECTION
92
LOW
SENSITIVITY
HIGH
SENSITIVITY
80
ATTENUATOR
83
a~b

FIG. 9

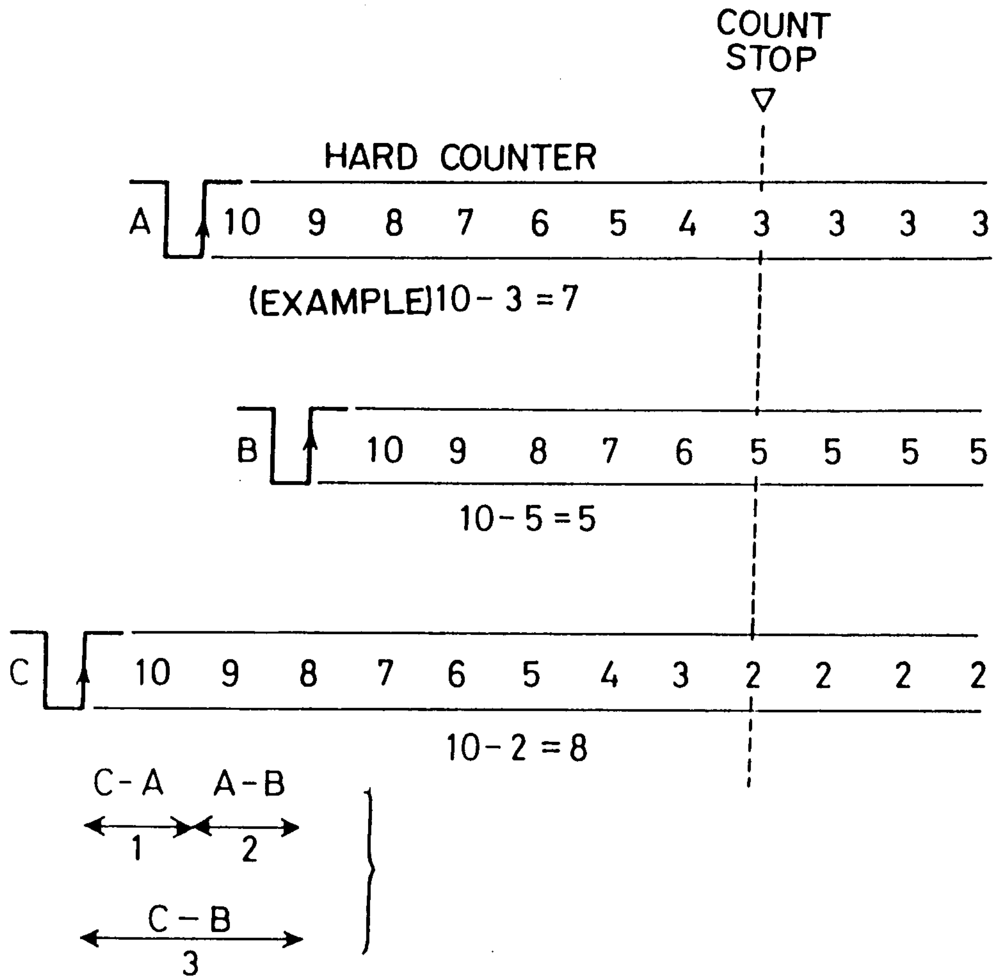

COUNT
STOP
HARD COUNTER
A
10 9 8 7 6 5 4 3 3 3 3
(EXAMPLE) 10 - 3 = 7
B
10 9 8 7 6 5 5 5 5
10 - 5 = 5
C
10 9 8 7 6 5 4 3 2 2 2 2
10 - 2 = 8
C - A
A - B
1
2
C - B
3

FIG. 10

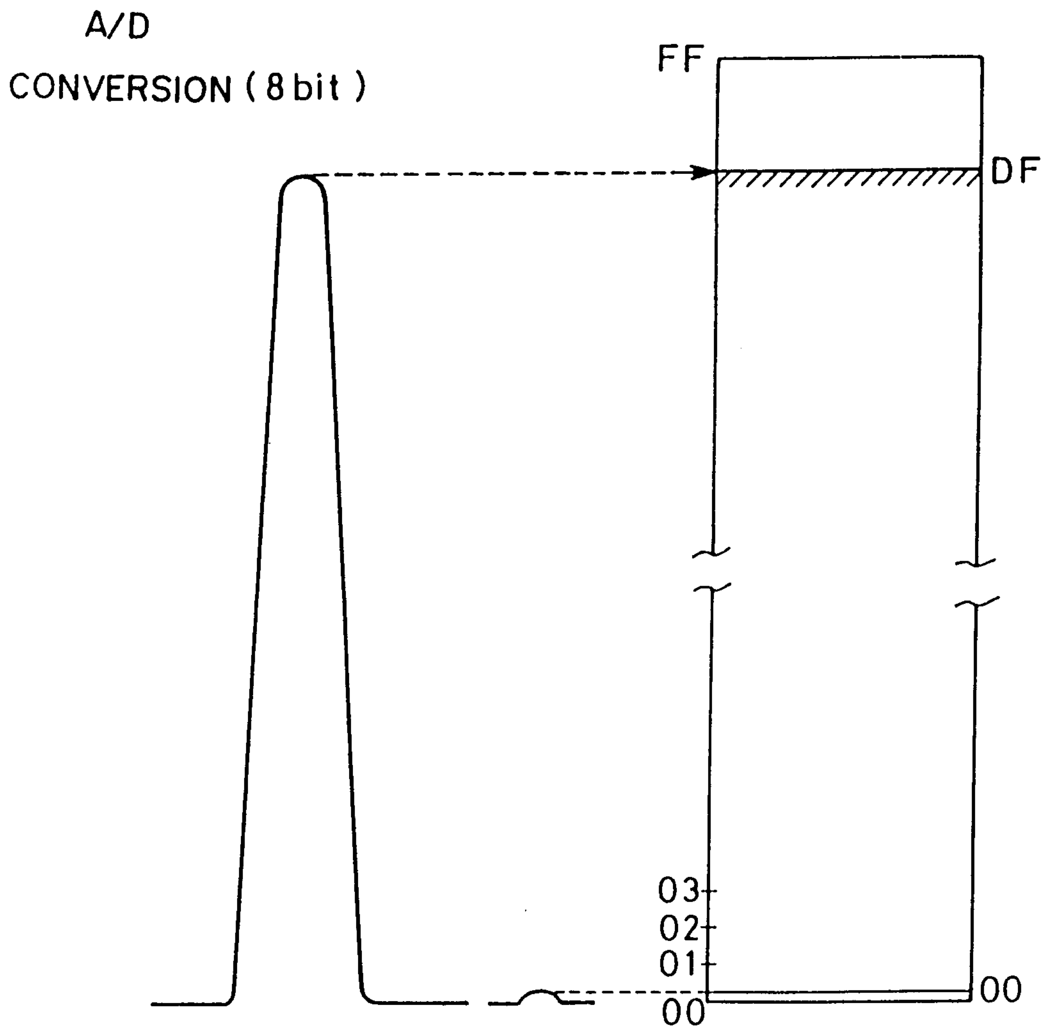


FIG. 11

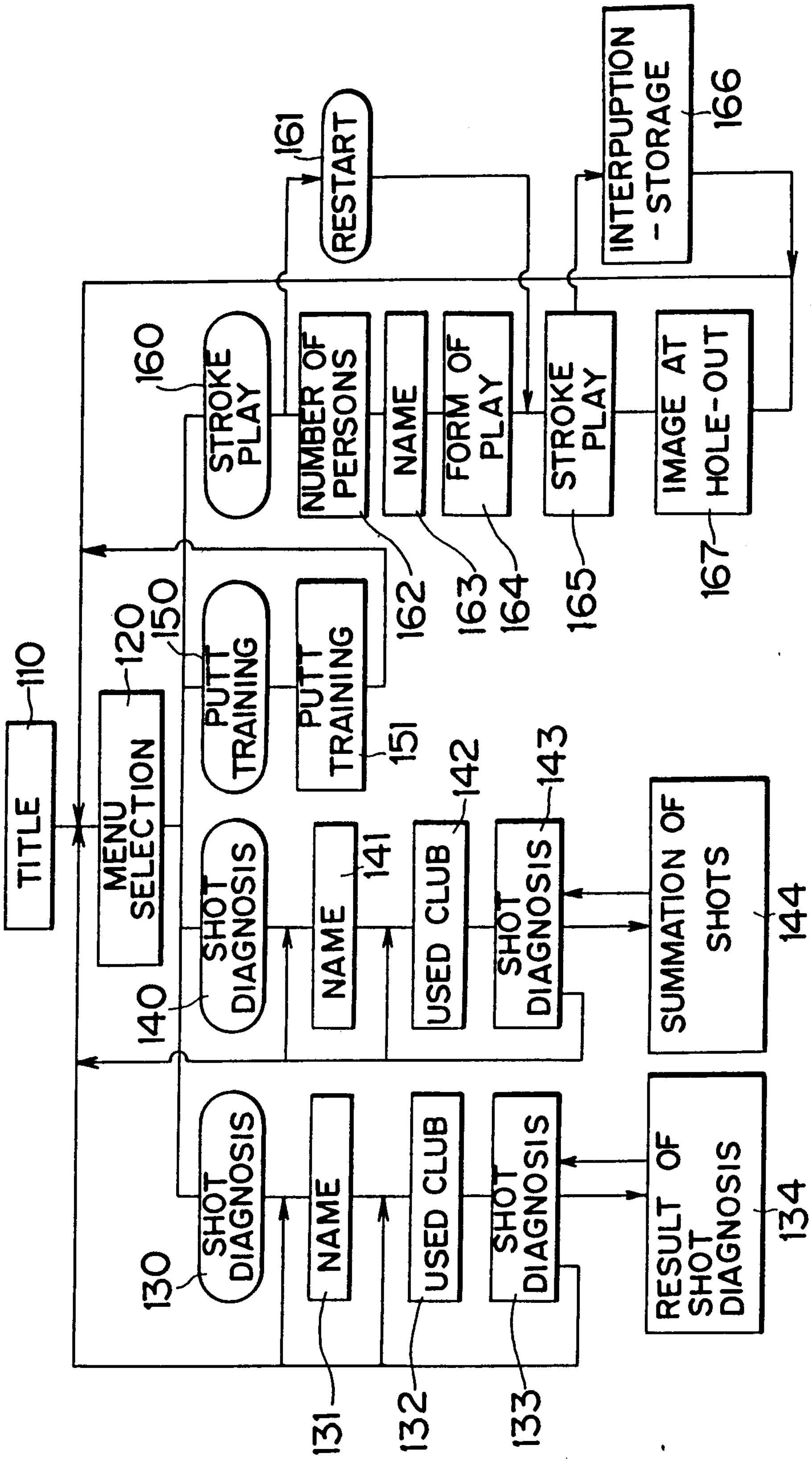

TITLE
110
MENU SELECTION
120
SHOT DIAGNOSIS
130
NAME
131
USED CLUB
132
SHOT DIAGNOSIS
133
RESULT OF SHOT DIAGNOSIS
134
SHOT DIAGNOSIS
140
NAME
141
USED CLUB
142
SHOT DIAGNOSIS
143
SUMMATION OF SHOTS
144
PUTT TRAINING
150
PUTT TRAINING
151
STROKE PLAY
160
RESTART
161
NUMBER OF PERSONS
162
NAME
163
FORM OF PLAY
164
STROKE PLAY
165
INTERRUPTION - STORAGE
166
IMAGE AT HOLE-OUT
167

FIG. 12

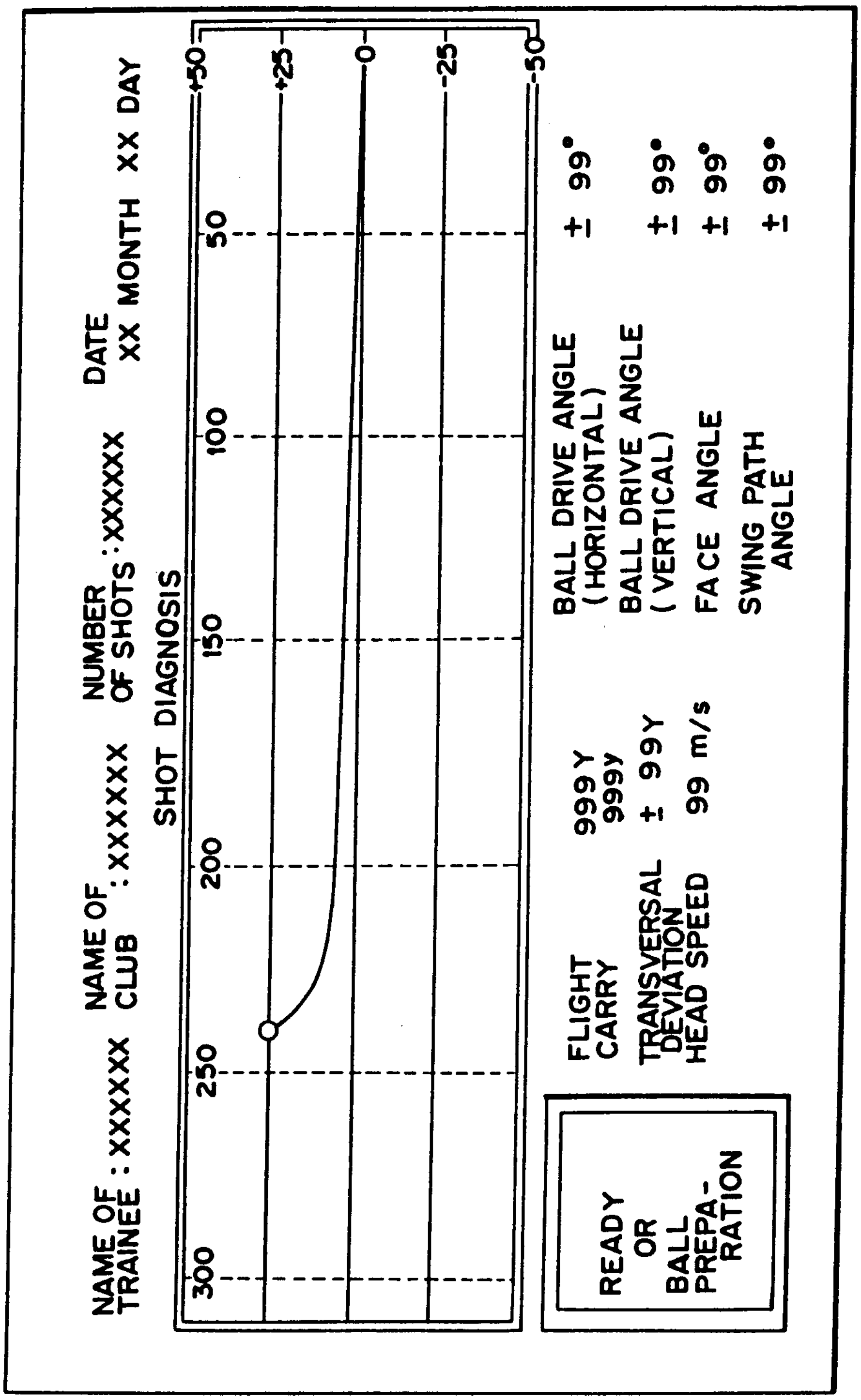

NAME OF TRAINEE : XXXXXX
NAME OF CLUB : XXXXXX
NUMBER OF SHOTS : XXXXXX
DATE XX MONTH XX DAY
SHOT DIAGNOSIS
300
250
200
150
100
50
+50
+25
0
-25
-50
READY OR BALL PREPA-RATION
FLIGHT 999Y
CARRY 999y
TRANSVERSAL DEVIATION ± 99Y
HEAD SPEED 99 m/s
BALL DRIVE ANGLE (HORIZONTAL) ± 99°
BALL DRIVE ANGLE (VERTICAL) ± 99°
FACE ANGLE ± 99°
SWING PATH ANGLE ± 99°

FIG. 13

RESULT OF SHOT DIAGNOSIS   NAME OF TRAINEE : XXXXXXX   EXECUTION DATE : ZZ YEAR ZZ MONTH ZZ DAY

NO.	NAME OF CLUB	FLIGHT (CARRY) [Y]	HEAD SPEED [m/s]	TRANSVERSAL DEVIATION [Y]	HORIZONTAL BALL DRIVE ANGLE	FACE ANGLE	SWING PATH ANGLE
99	XXXXXX	ZZZ(ZZZ)	ZZ	R ZZZ	R ZZ	OPEN ZZ	IN-OUT Z
99	XXXXXX	ZZZ(ZZZ)	ZZ	L ZZZ	L ZZ	CLOSE ZZ	OUT-IN Z
99	XXXXXX	ZZZ(ZZZ)	ZZ	SQUARE	CENTER	SQUARE	SQUARE

FIG. 14

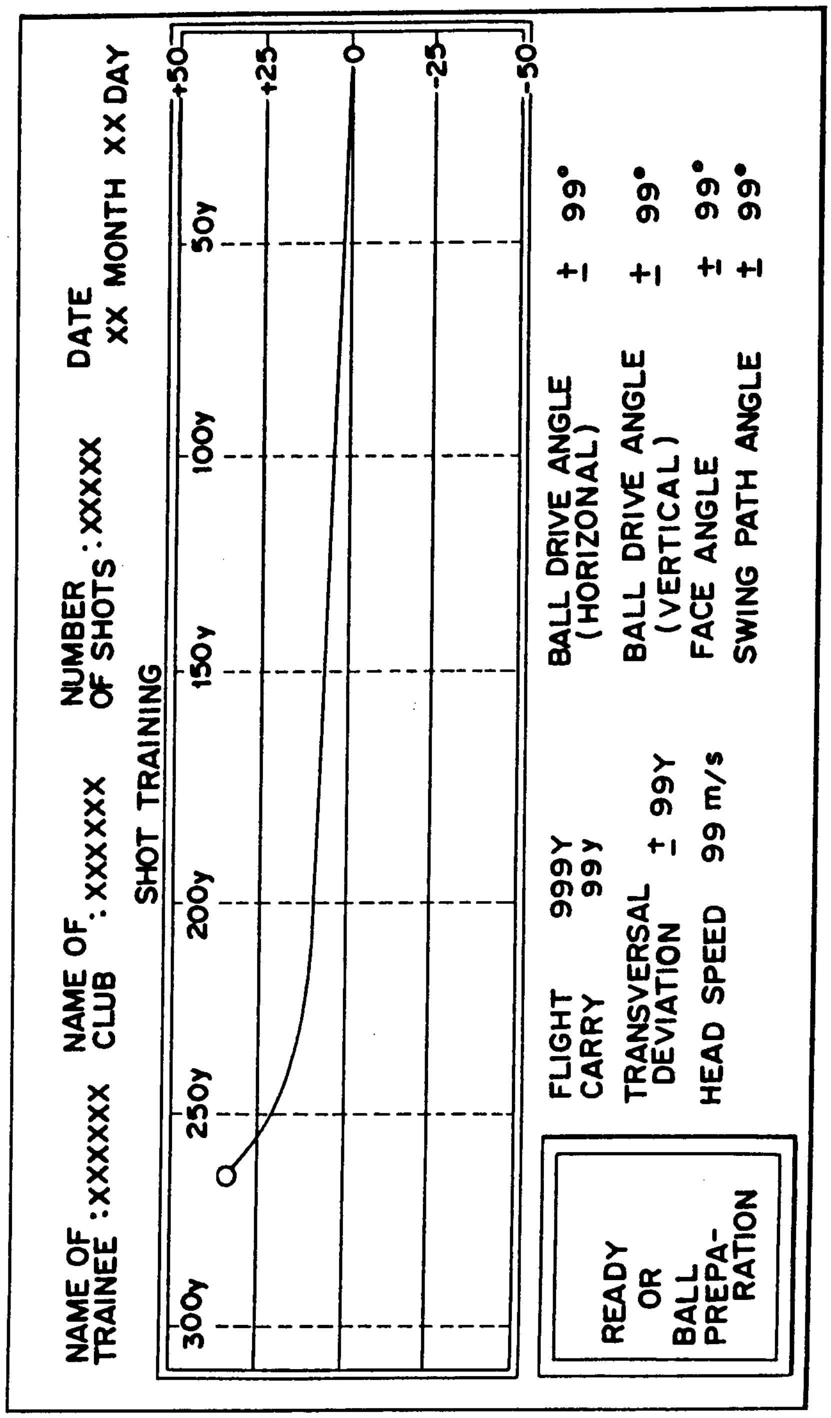

NAME OF TRAINEE : XXXXXX
NAME OF CLUB : XXXXXX
NUMBER OF SHOTS : XXXXX
DATE XX MONTH XX DAY
SHOT TRAINING
300y
250y
200y
150y
100y
50y
+50
+25
0
-25
-50
READY OR BALL PREPA-RATION
FLIGHT 999Y
CARRY 99y
TRANSVERSAL DEVIATION ± 99Y
HEAD SPEED 99 m/s
BALL DRIVE ANGLE (HORIZONAL) ± 99°
BALL DRIVE ANGLE (VERTICAL) ± 99°
FACE ANGLE ± 99°
SWING PATH ANGLE ± 99°

FIG. 15

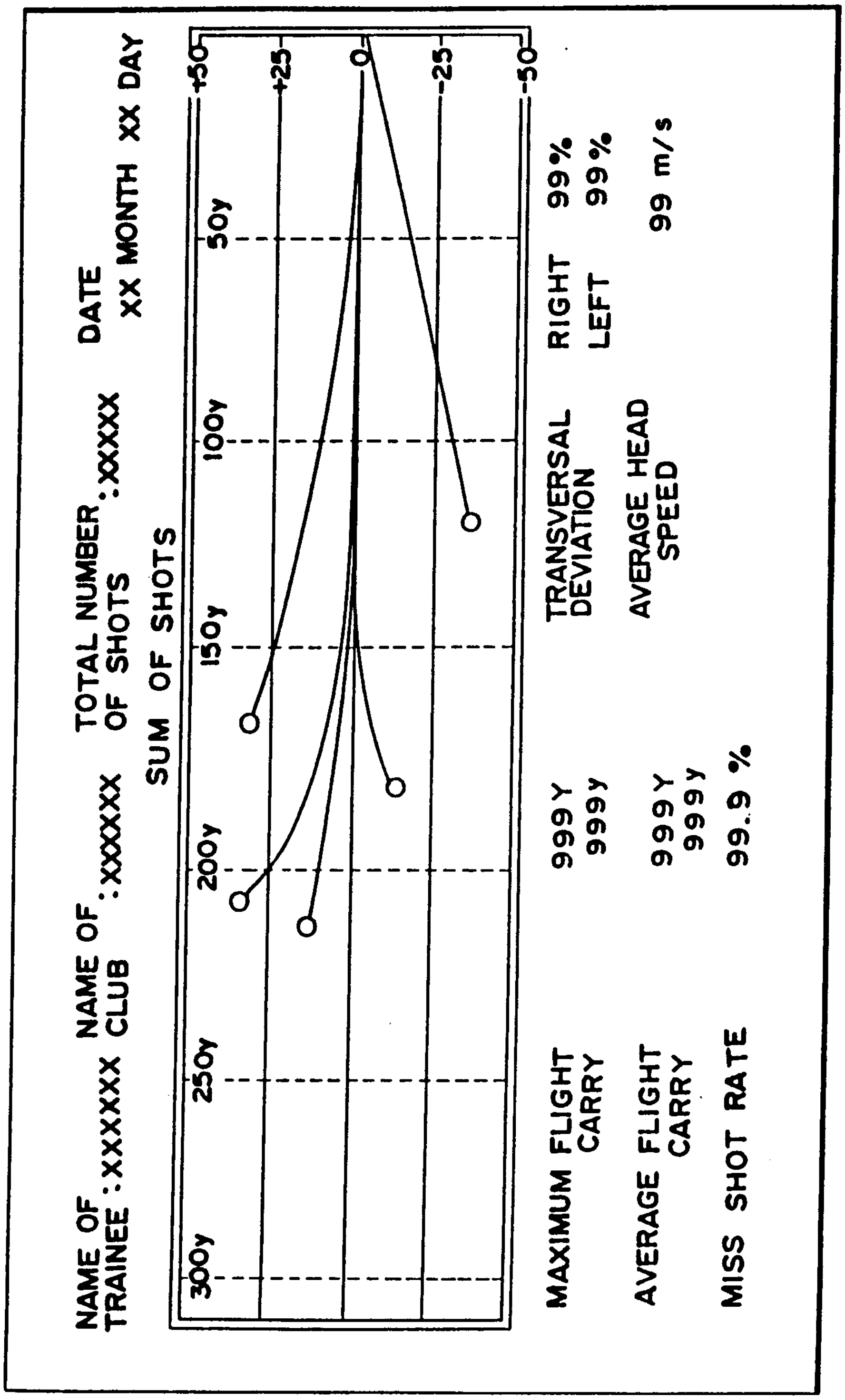

NAME OF TRAINEE : XXXXXX
NAME OF CLUB : XXXXXX
TOTAL NUMBER OF SHOTS : XXXXX
DATE
XX MONTH XX DAY
SUM OF SHOTS
300y
250y
200y
150y
100y
50y
+50
+25
0
-25
-50
MAXIMUM FLIGHT CARRY
999Y
999y
TRANSVERSAL DEVIATION
RIGHT 99%
LEFT 99%
AVERAGE FLIGHT CARRY
999Y
999y
AVERAGE HEAD SPEED
99 m/s
MISS SHOT RATE
99.9 %

FIG.16

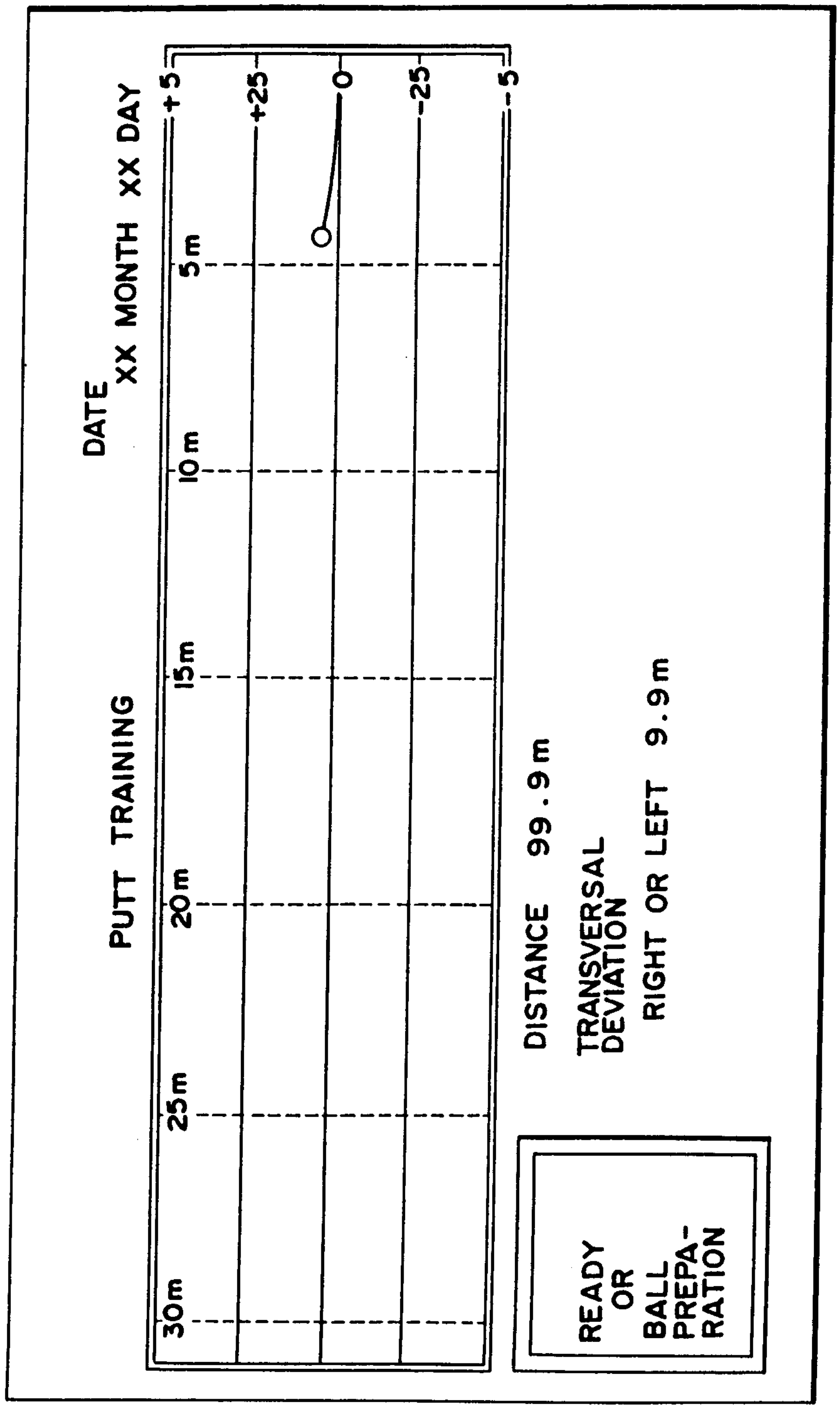

PUTT TRAINING
DATE
XX MONTH XX DAY
+5
+25
0
-25
-5
5m
10m
15m
20m
25m
30m
DISTANCE 99.9 m
TRANSVERSAL DEVIATION
RIGHT OR LEFT 9.9 m
READY OR BALL PREPA-RATION

FIG. 17

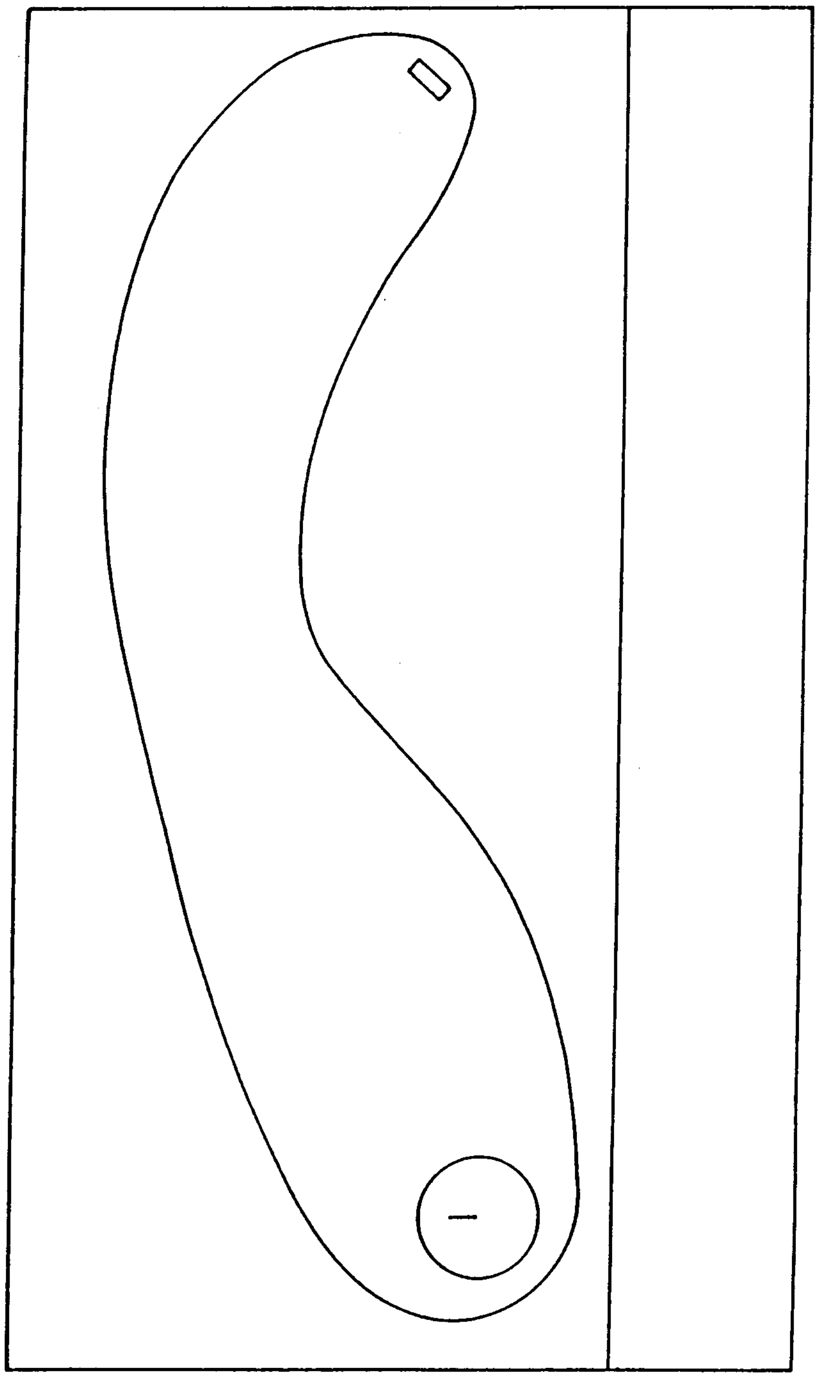
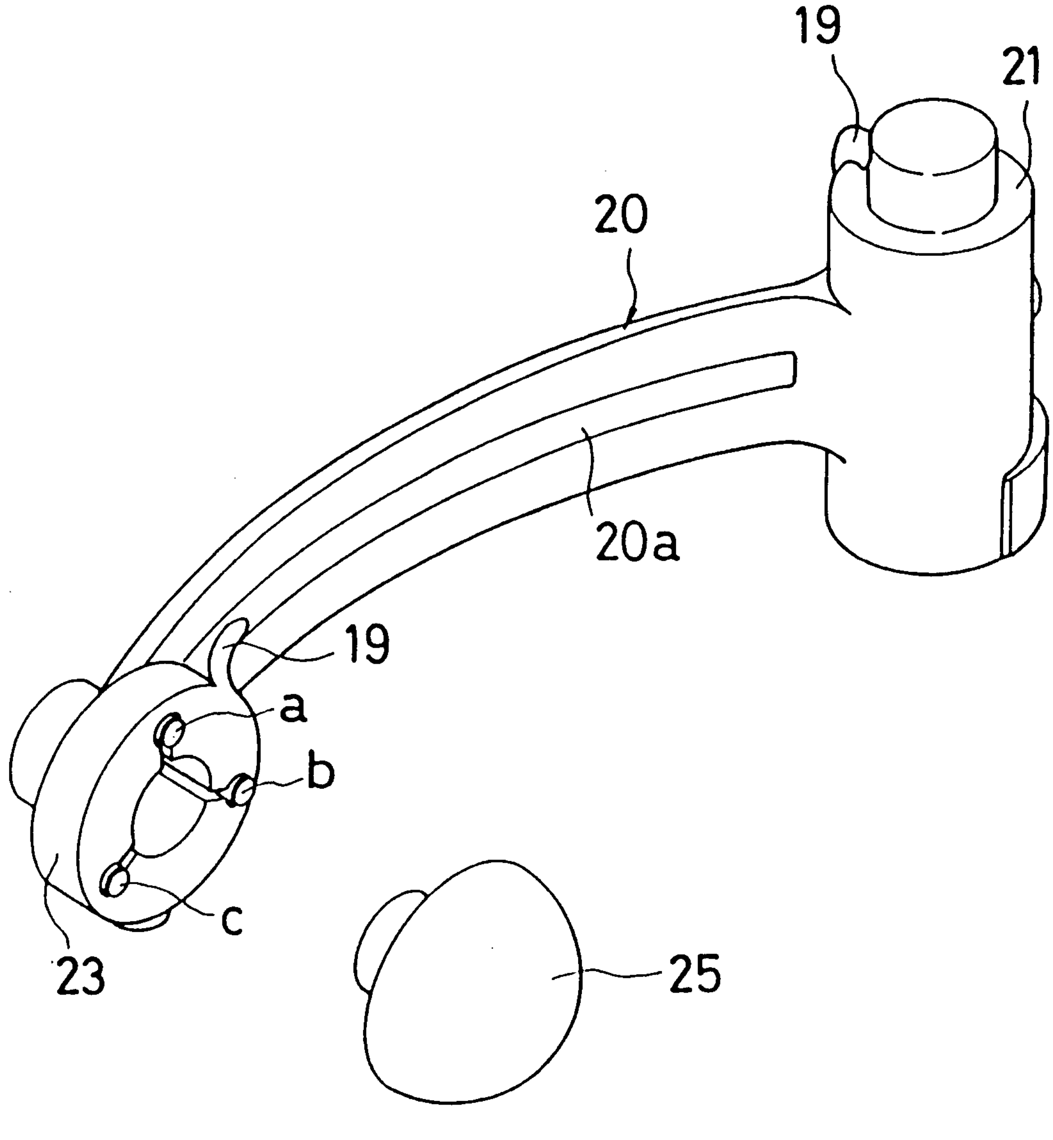


FIG. 18



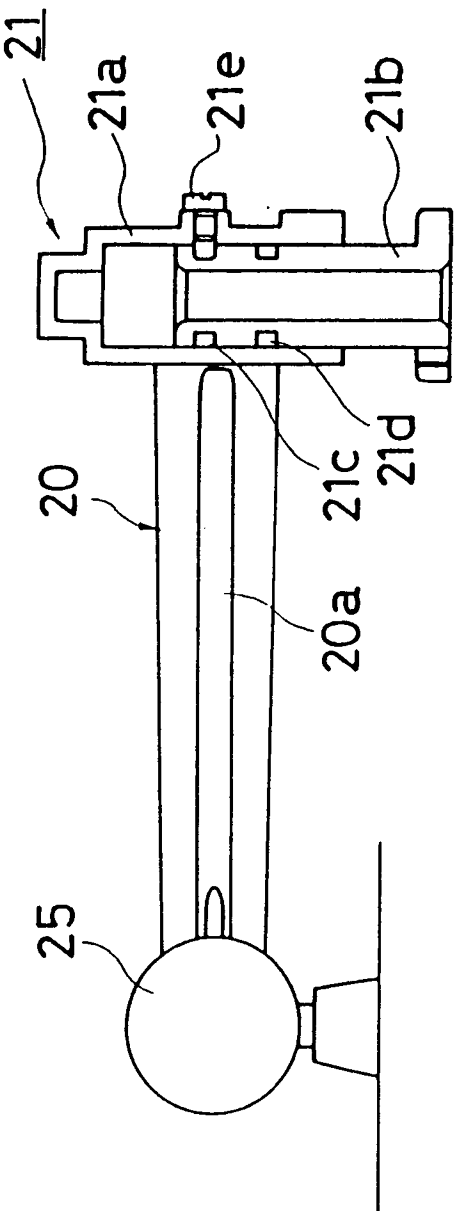


FIG.19A

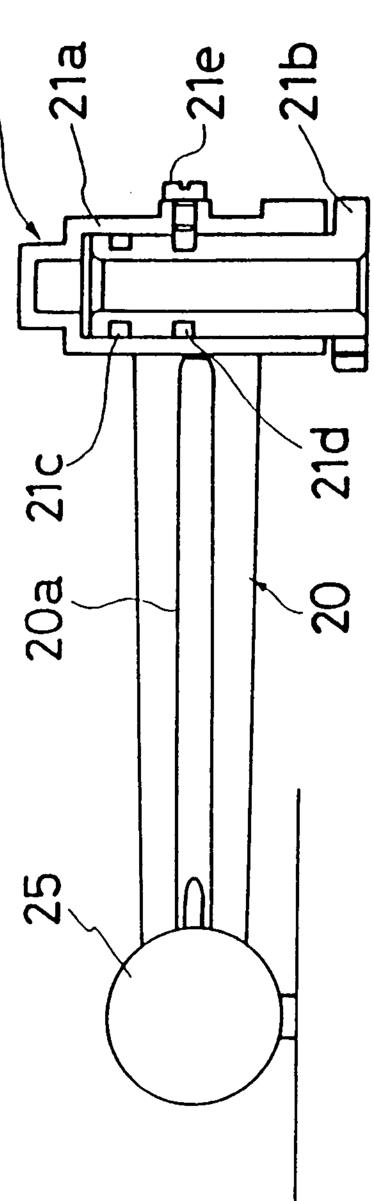


FIG.19B

FIG. 20

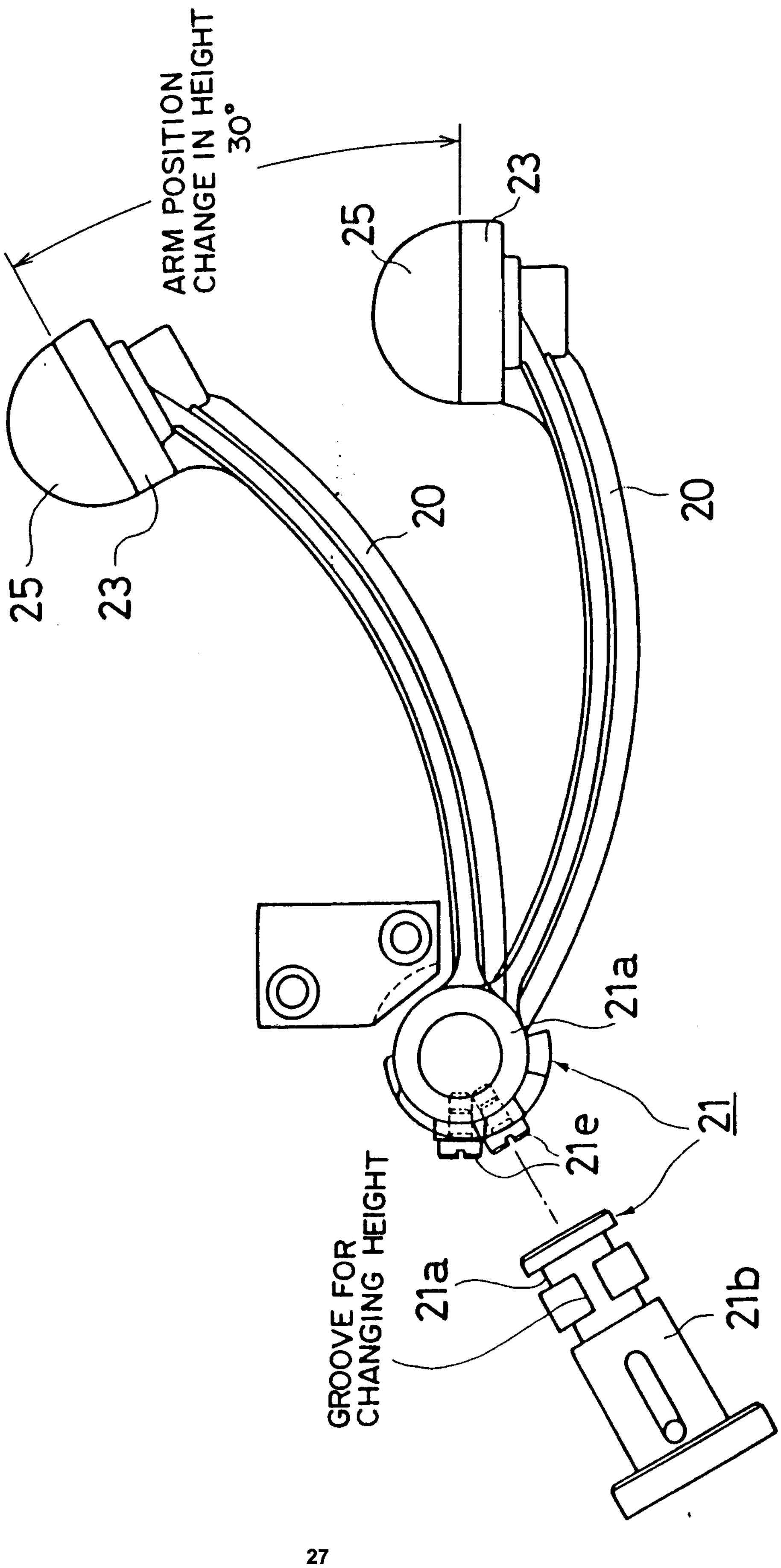

ARM POSITION
CHANGE IN HEIGHT
30°
25
23
20
21a
21
21e
GROOVE FOR
CHANGING HEIGHT
21b

FIG.21A

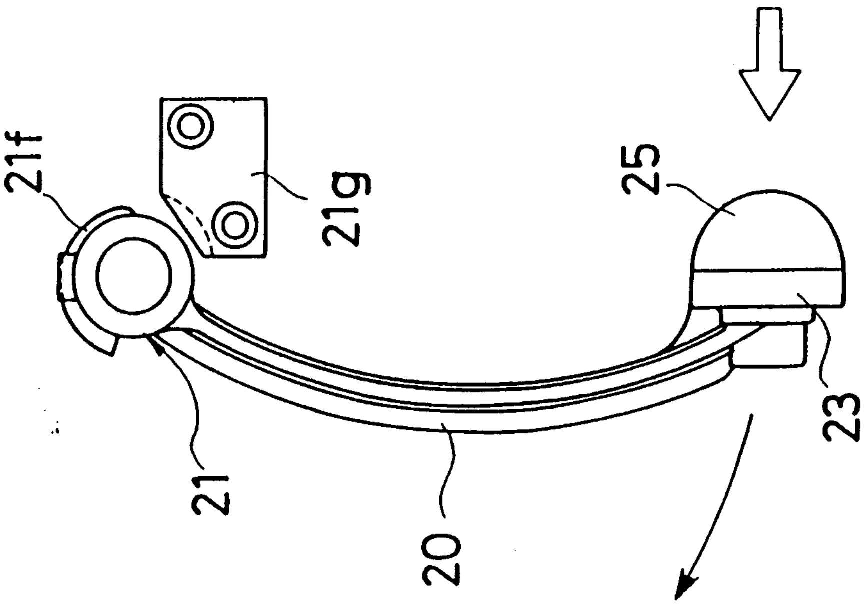


FIG.21B

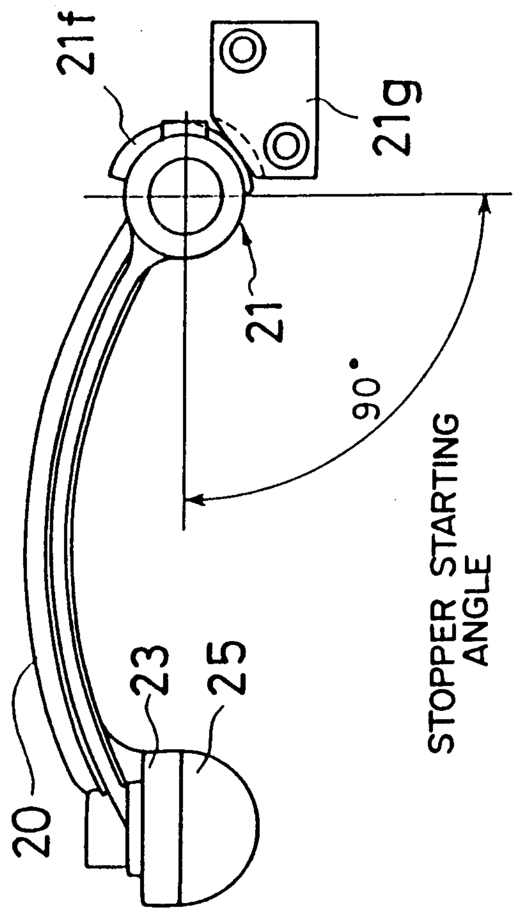


FIG. 22

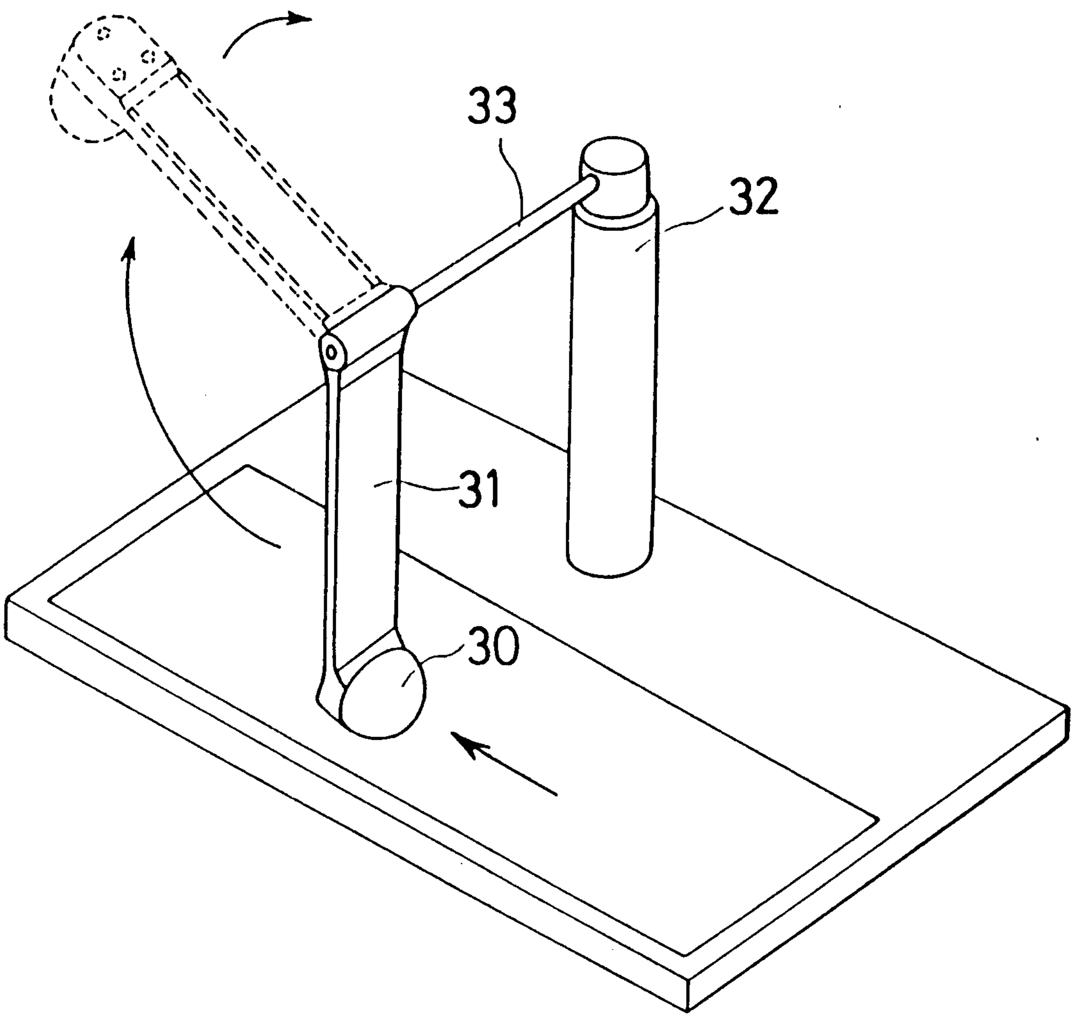
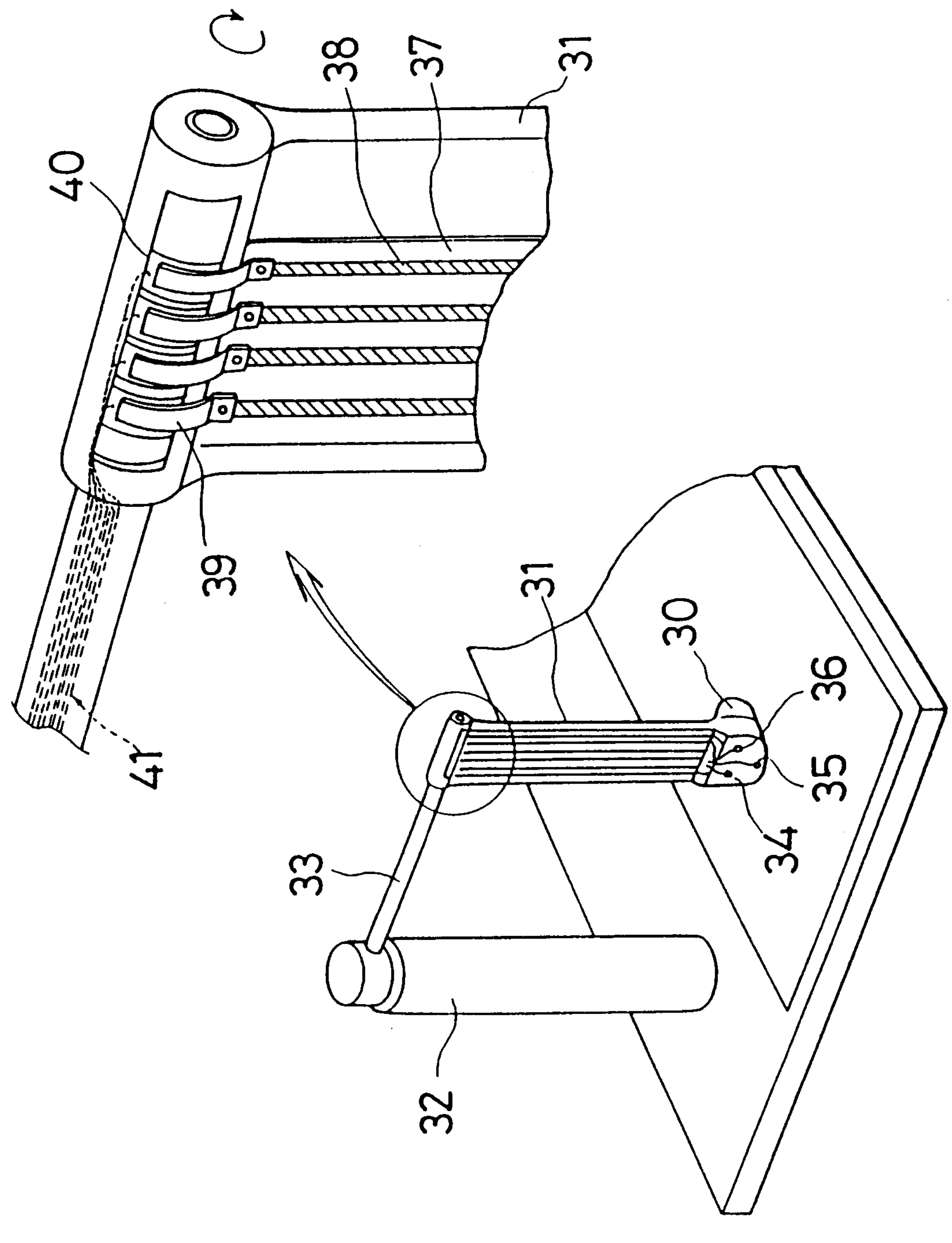


FIG.23



European Patent Office

EUROPEAN SEARCH REPORT

Application Number

EP 93 30 3858

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.5)
X	US-A-4 848 769 (BELL ET AL.) * abstract; figures 1,2 *	1,2,5,7	A63B69/36
A	* column 3, line 61 - column 4, line 23 *	3	
A	EP-A-0 376 846 (SONY CORPORATION) * column 6, line 41 - line 46; figure 5 *	3,6	
A	DE-A-3 636 515 (GRENFELDT) * claims 1,5; figures 1,2 *	1,7	
A	US-A-4 775 948 (DIAL ET AL.) * abstract *	1	

TECHNICAL FIELDS SEARCHED (Int. Cl.5)

A63B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	15 SEPTEMBER 1993	JONES M.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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