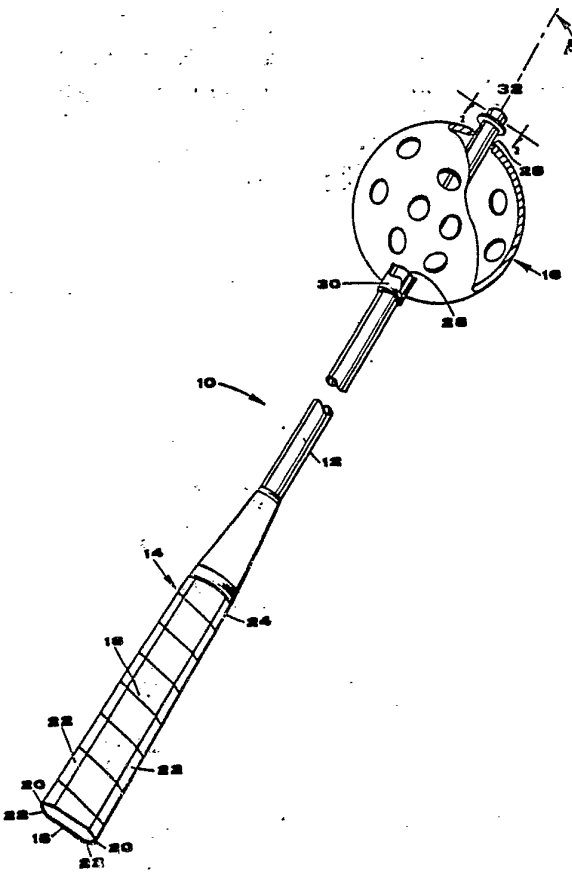




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification³ : A63B 69/36, 69/38, 71/02, 49/08</p>	<p>A1</p>	<p>(11) International Publication Number: WO 80/00062 (43) International Publication Date: 24 January 1980 (24.01.80)</p>
<p>(21) International Application Number: PCT/US79/00433 (22) International Filing Date: 14 June 1979 (14.06.79) (31) Priority Application Number: 916,237 (32) Priority Date: 16 June 1978 (16.06.78) (33) Priority Country: US (71) Applicant; and (72) Inventor: HEDGE, Roger, Arden [US/US]; 451 Laswell Avenue 2, San Jose, CA 95128 (US).</p>		<p>(74) Agent: RADKE, Richard, P.; P.O. Box 1315, 8399 Topanga Canyon Blvd., Suite 213, Canoga Park, CA 91304 (US). (81) Designated States: DE, DK, GB, JP, SE. Published with: <i>International search report</i></p>
<p>(54) Title: RACKET SPORT TRAINING DEVICE</p> <p>(57) Abstract</p> <p>Training devices which make it easier for a player to learn correct strokes in any of a multiplicity of racket sports. Racket games such as badminton, tennis, racket ball, and squash are enjoying unparalleled popularity among those persons fond of the active participant sports. Every year hundreds of thousands of people take up a racket for the first time to play one of these healthful and invigorating games. Among these multitudes, there are many people who wish to attain levels of achievement in the sport greater than that of a casual player. Unfortunately, such training usually mandates that the player find a top notch instructor, of whom there are all too few. The present invention overcomes this problem by providing a racket sport training device (10) for a player to use against a flat surface (42) (such as a wall), and including an elongated shaft (12), a handle (14) attached to one end of the shaft, and a ball (16) or other rotatable member (16') attached proximate to the other end of the shaft. The rotatable member (16, 16') is adapted to contact and follow the flat surface (42) in order to guide a racket sport player through the correct arm and wrist motion for the racket ball sport being practiced.</p> 		

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TECHNICAL FIELD

This invention relates generally to sports equipment and more particularly to training devices
5 which make it easier for a player to learn correct strokes in any of a multiplicity of racket sports.

BACKGROUND OF THE PRIOR ART

Racket games such as badminton, tennis, racket ball, and squash are enjoying unparalleled popularity
10 among those persons fond of the active participant sports. Every year hundreds of thousands of people take up a racket for the first time to play one of these healthful and invigorating games. Among these multi-
15 tudes, there are many people who wish to attain levels of achievement in the sport greater than that of a casual player. For these people, proper and adequate training in the fundamental strokes is a necessity.

Unfortunately, such training usually mandates that the player find a top notch instructor, of whom
20 there are all too few. Even after a good instructor is found, training in even the fundamentals of a racket sport game is an extremely time consuming process and thus often a very costly one.

While instructional methods vary, all methods
25 seem to have a few common features. Typically, after the instructor discusses the particular stroke to be worked upon (for example, the forehand stroke or the overhead smash) the player is asked to take his or her racket in hand and swing it about as if hitting an
30 imaginary ball or birdie. A fundamental problem with this method of instruction is that the player has no reliable way of knowing as to whether his stroke is really correct or not. Especially in larger classes, a player may practice a stroke incorrectly for an entire
35 class session. If the student continues to practice the stroke incorrectly, his incorrect technique may become so ingrained that it could take years to unlearn.

Another instructional method sometimes used in small classes is called the "manual guidance method".



An instructor utilizing this method would grasp the student by the wrist or arm and guide the student through a correct stroke. While this method of instruction may be helpful in giving the student an intellectual conceptualization of what a correct stroke should be, it is an extremely inefficient way of training the student to use his own musculature to swing the racket through a stroke since the instructor is supplying all of the motive force. Learning a stroke by the manual guidance method is likened to a piano student learning to play the piano by having his teacher press his fingers on the correct keys instead of having the student learn to use his own brain and muscles to produce the correct notes.

What is sorely needed in the field of racket sport training devices is a device which, under the action of the students own musculature, guides the students arm and wrist through a correct stroke time-after-time. Furthermore, such a device should be usable by a player without need for instructional supervision.

To my knowledge, no such device exists in the prior art.

BRIEF SUMMARY OF THE INVENTION

It is a major objective of my invention to provide a racket sport training device which, without fail, guides a student through a correct racket ball sport stroke. Furthermore, it is my objective to provide the above-mentioned object with a device that requires little supervision from instructor.

Yet a further objective of my invention is to provide a racket sport training device which can provide an indication of the efficiency and correctness of the stroke by the means of a suitable feedback or readout device.

Briefly, my invention comprises an elongated shaft having a first and a second end and defining an axis therethrough, a handle attached to a first end of the shaft, a surface following means (such as a ball, disk or wheel) defining a second axis and for contacting

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and following a flat surface, and means for attaching the surface following means proximate a second end of the shaft so that the axis of the shaft and the axis of the surface following means are coaxial.

5 A material advantage of my invention is that, after assimilating a few simple instructions, a player can use my device to quickly and easily learn a correct racket sport stroke with practically no supervision from an instructor. Furthermore, when my device is
10 provided with a monitoring apparatus, the efficiency and correctness of each of the players strokes can be displayed to provide a very instructive feedback mechanism.

15 These and other objects and advantages of my present invention will no doubt become apparent to those skilled in the art after having read the following detailed description as accompanied by the several figures of the drawing.

BRIEF DESCRIPTION OF THE DRAWINGS

20 Fig. 1 is a partially broken perspective view of a racket sport training device in accordance with my present invention;

Fig. 2 is a cross-sectional view taken along line 2-2 of Fig. 1;

25 Fig. 3 is a pictorial representation of a player using the device shown in Fig. 1;

Fig. 4 is a pictorial representation of a player using the device shown in Fig. 1 with an optional or accessory portable surface means in accordance with
30 my invention;

Fig. 5 illustrates a first alternate embodiment for a racket sport training device in accordance with my present invention;

35 Fig. 6 illustrates a second alternate embodiment of my racket sport training device;

Fig. 7 illustrates a third alternate embodiment of my racket sport training device; and

Fig. 8 illustrates yet another alternate embodiment for a racket sport training device in



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accordance with my present invention.

DETAILED DESCRIPTION OF THE INVENTION

In this disclosure my racket sport training device is shown and described in a configuration which makes it very suitable for the training of badminton strokes. It should be clearly understood, however, that with suitable and minor modifications my device can be used to teach proper wrist and arm motions for strokes associated with other racket sports such as squash and racketball. For example, by shortening the shaft and adding a little weight to the head of the device shown in Fig. 1 it could be used to train a player in the proper method of swinging a racketball racket.

In Fig. 1 and Fig. 2, my racket sport training device 10 may be seen to include an elongated shaft means such as a shaft 12, a handle means such as a handle 14 and a surface following means such as a "wiffle" type ball 16. Shaft 12, in this embodiment, is a round bar which is preferably constructed from a strong yet lightweight material such as aluminum. The visible length of the shaft is approximately 12 inches long when my device is adapted for teaching badminton strokes. When adapted for racketball, the exposed shaft length is preferably slightly shorter than 12 inches and when adapted for squash, the exposed shaft length is preferably slightly longer than 12 inches. Shaft 12 could also be of a hollow or tubular construction to minimize the weight of my device.

Handle 14 is typically an elongated member having eight side surfaces, and is usually permanently attached to one end of shaft 12 as shown. The handle has a wide, flat pair of opposing surfaces 18 which would normally be parallel to the face of a racket, and a slightly narrower pair of flat opposing surfaces 20 which would normally be perpendicular to the face of a racket. Beveled surfaces 22 connects surfaces 18 and 20 to provide a comfortable, slightly rounded surface for the handle. Usually a handle tape 24 is wrapped

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around the handle so as to provide a sure grip for a user's hand.

Wiffle type ball 16 is provided with an aperture means, such as that created by holes 26 and 28, for receiving the end portion of shaft 12. Holes 26 and 28 are aligned along a major axis of ball 16, which is coaxial with the axis "A" of shaft 12.

A sleeve means such as sleeve 30 is attached around shaft 12 to prevent ball 16 from sliding down the shaft. Sleeve 30 is typically a short piece of cylindrical tubing that is adhesively or otherwise attached coaxially about the shaft. It is also possible to form a sleeve 30 by wrapping a piece of friction tape around the shaft.

A cap 32, which in this preferred embodiment is a standard axle cap, is press fit over the free end of shaft 12 to prevent ball 16 from sliding off the end of the shaft. Ball 16 is thus loosely held between members 30 and 32 so that it may freely spin upon shaft 12. If imparted with a sufficient rotational force, the ball will spin quite freely for a number of seconds.

In Fig. 3, a player 34 is shown using my device D against a wall 36 in order to learn a correct forehand, underhand stroke. In this stroke, the player grasps the handle of my device so that the V-shaped fold of flesh between his or her thumb or forefinger is aligned with one of surfaces 20, and the player's arm is held out from the body so that it is substantially parallel to the floor.

The player begins his stroke with my training device in the position labeled "P", which corresponds to the preparatory position of a badminton swing. The wrist is cocked and the arm is twisted so that the palm of the hand faces upwardly and slightly towards wall 34. The player then strokes forwardly with my device, as indicated by arrow 38, while at all times keeping ball 16 rolling along the wall. When ball 16 is in position 40, the arm and wrist of player 34 is in the correct position to hit the imaginary shuttle 42 as

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shown. This is known as the contact point and is denoted by the letter "C". The player then continues to follow through with the stroke, still rolling ball 16 along wall 36, until the racket sport training device
5 is in a substantially vertical position. This is known as the follow through position and is denoted by the letter "F". In the follow through position, ball 16 should be separated from the wall by a slight fraction of an inch, the wrist should be cocked, and the palm
10 should face outwardly from the wall. If the stroke was an effective and powerful one, ball 16 would be whirling vigorously to indicate good acceleration and smooth stroking. If ball 16 is only rotating feebly, it is an indication that perhaps the stroke was per-
15 formed in a jerking manner, that it was not performed along that flat vertical surface of wall 36, or that the acceleration of the stroke was slow.

The back-hand stroke (not illustrated) is very similar to the forehand stroke. In this stroke the
20 player faces in the opposite direction along wall 36 in a starting position with his wrist cocked, and his palm facing outwardly from the wall. The stroke is then performed in a similar manner to that of the forehand stroke except that the final or follow through position
25 is with his wrist cocked and palm towards the wall.

The theory of operation for my invention is believed to be as follows. For a truly efficient power stroke, it is necessary that the force exerted by a player's racket upon a shuttle is primarily in
30 the direction of the desired shuttle flight. Any motion imparted to the shuttle that is not in its desired direction of flight will have been expended to no useful purpose (this of course does not include such esoteric techniques as "drop shots", etc.). In part,
35 the purpose of my device is to force a player to move his racket head along the plane of the shuttle's intended flight. My device further insures that the correct wrist and arm action is used if only the racket started and stopped in the correct preparatory and

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follow through positions. Consequently, a player uses his own musculature to perform near-perfect badminton strokes from the very first when using my training device. It has been found that beginning players
5 using my device can learn a badminton stroke in a few short hours, something which otherwise might take many years of practice.

Referring now to Fig. 4, an apparatus 42 is shown which allows my racket sport training device 10
10 to be used to teach overhead strokes. Learning overhead strokes against a wall, such as wall 36, is impossible since it would necessitate that the player stand within the plane of the wall. My device 10 has been used successfully to teach the overhead stroke by
15 having a player stand in a doorway and use the trestle thereabove for the flat, vertical surface. However, a suitable doorway is not always available and for this reason, apparatus 42 is preferable.

Apparatus 42 includes a base portion 44 which
20 is disposed on a flat, horizontal surface such as a floor, a pair of posts 46 and 48 and a backboard 40 which is provided with a pair of vertical bores 50 and 54 into which respective ends of shaft 46 and 48 are inserted. A pair of adjustable sleeve members 56 and
25 58 are provided to prevent the backboard from sliding down the posts. By adjusting the height of the sleeves above the base, the height of the backboard can be adjusted to accommodate players of various heights. The backboard 50 may also be dropped to the level of a
30 player's midbody to provide a flat, vertical surface on which to practice underhand strokes.

In use, a player wishing to learn overhead strokes stands under the backboard 50 and places ball 16 of my device 10 against a rear surface thereof as
35 shown. The players start in preparatory position "P" with his wrist cocked and palm facing towards backboard 50, swings through an imaginary birdie at contact point "C" and follows through to follow through to a position "P" where his wrist is extended and radially



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flexed, his forearm pronated and his upper arm medially rotated.

Of course, an apparatus for providing a flat, planar surface on which to practice overhead strokes need not be portable as shown. For instance, a back-board could be mounted parallel to and slightly spaced from a wall by means of suitable brackets.

Referring now to Fig. 5, an alternate embodiment of my invention includes a transducer means such as a generator 60 which has a housing portion 62 and a rotary shaft 64. Housing 62 is attached coaxially to the free end of shaft 12 and shaft 64 is attached to ball 16 by a fastener such as bolt 66. As ball 16 is spun during a practice stroke, shaft 64 is imparted with a spin. This causes an electrical signal to be developed between a pair of lines 68 which can be detected by a monitoring apparatus 70 having one or more of the plurality of output devices shown. For instance, a digital output 72 could display the total number of revolutions performed by ball 16, its maximum acceleration, or any other pertinent and helpful data. A strip recorder 74 could, for example, record the rotational velocity of ball 16 from the preparatory stage to the follow through stage and beyond. An audio output device such as speaker 76 could produce a tone proportional to the rotational speed of the ball and thus act as a valuable and continuous feedback mechanism for the player. Similarly, a light emitting device 77 or a meter 78 could provide a visual display of the voltage level developed between line 68 and thus indicate how fast ball 16 is spinning. As mentioned earlier, the speed of rotation of the ball is a good indication of the correctness of the stroke. In one embodiment of my invention, a lightbulb is disposed within ball 16 so that the ball is illuminated from within to provide the player with immediate visual feedback as to the efficiency of his strokes.

Another means for monitoring the efficiency of the players stroke is shown in Fig. 6 to include a

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revolution meter 80 having a housing portion 82 and a shaft 84. Housing 82 is attached coaxially to the free end of shaft 12 and shaft 84 is attached to a solid ball 12' by means of a stud 86. Meter 80 has a digital readout 88 for indicating the number of revolutions that ball 12' undergoes. Note that, in this embodiment, ball 12' is a solid, spherically-shaped member having an inner core 90 and an outer covering 92. This solid ball tends to rotate longer than the hollow one due to a flywheel-like action. Outer covering 92 is preferably a material of a high frictional coefficient (such as rubber) so that it may more positively engage one of the flat surfaces discussed earlier.

In Fig. 7, several means for adjusting the "feel" of my racket sport training device are illustrated. In this embodiment, a handle 14' is provided with a bore 94 into which a thumb screw 96 may be screwed. The end of shaft 12' is disposed within shaft 94 and is held therein by firmly tightening thumb screw 96. This embodiment further includes a weight 98 provided with an axial bore 100 and a thumb screw 102 which may be screwed into that bore. The weight can be disposed at various positions along shaft 12' and can be immobilized by tightening down thumb screw 102. Thus, the exposed length of shaft 12' may be adjusted by sliding its end in and out of bore 94 and the weight distribution of my device may be adjusted by varying the position of the weight along the shaft.

With these two adjustments, a single device in accordance with my invention can be used to train players for many different racket sports. For instance, a short shaft and heavy head would be good for training racket ball strokes and a long shaft and light head would be good for training badminton strokes.

In Fig. 8, another embodiment for my device includes a disk-like surface following means 104 that is nonrotatably attached to an end portion of shaft 12' by a pair of nuts 106 and 108. Disk 104 of this embodiment does not rotate with respect to the shaft



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but it could do so if it were loosely attached to the shaft rather than being clamped between the bolts. The disk of this embodiment should be made out of a material having a low coefficient of friction, such as a polished stainless steel or a very hard plastic, so that there is very little drag as outer surface 110 follows a wall or other flat surface.

The embodiment of Fig. 8 illustrates the very important fact that the shape of the surface following means is not critical as long as it is configured so as to be radially symmetrical about the axis of the shaft means.

Although this invention has been described in the light of a few preferred embodiments, it is contemplated that various modifications and permutations thereof will become apparent to those skilled in the art after having read the preceding detailed description.

For example, a rotary wheel could be attached to shaft 12 to perform the same surface following task as the previously described balls or disk. Also, many other means for monitoring the efficiency of the strokes are possible, such as forming whistle producing apertures around the surface of a ball in order to produce a whistling sound having a frequency dependent upon the speed of rotation of the ball. Furthermore, the surface that my device is used against may be curved, non-vertical or many other configurations.

It is therefore intended that the following appended claims be interpreted as covering all such modifications and permutations as fall within the true spirit and scope of my invention.



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CLAIMS

A racket sport training device for a racket sport player to use against a surface and comprising: an elongated shaft means having a first end and a second end and defining a first axis; a handle means having a first and a second end; first means for fastening said handle means to said first end of said elongated shaft means; surface following means for contacting and following said surface; and second means for attaching said surface following means proximate to said second end of said shaft means, whereby a person who grasps said handle, disposes said surface following means against said surface and swings through an imaginary shuttle or ball is guided through a correct racket stroke.

2. The racket sport training device as claimed in Claim 1, wherein said surface following means includes a member that is symmetrical about a second axis which is coaxial with said first axis.

3. The racket sport training device as claimed in Claim 2, wherein said member is provided with an aperture means receptive to said second end portion of said shaft means.

4. The racket sport training device as claimed in Claim 3, wherein said member is spherically shaped and said second axis is a major axis of said spherically shaped member.

5. The racket sport training device as claimed in Claim 4, wherein said spherically shaped member is substantially solid and said aperture means comprises a bore formed coaxially with said second axis.

6. The racket sport training device as claimed in Claim 4, wherein said spherically shaped member is hollowed and said aperture means comprises a pair of opposing holes formed through the surface of said member along the line of said second axis.

7. The racket sport training device as claimed in Claim 5, or 6 wherein a portion of said shaft means proximate said second end is disposed completely through



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said aperture means of said member, and wherein said second means comprises; a sleeve means attached coaxially about said shaft means between said member and first end; and a cap means attached over said second end of said shaft means; whereby said member is free to rotate about said shaft means and is retained between said sleeve means and said cap means.

8. The racket sport training device as claimed in Claim 3, wherein said member is disk shaped.

9. The racket sport training device as claimed in Claim 1, wherein said handle means includes an elongated bore extending from a first end thereof at least partially towards said second end thereof.

10. The racket sport training device as claimed in Claim 9, wherein said first means includes means for permanently attaching said first end portion of said shaft within said elongated bore.

11. The racket sport training device as claimed in Claim 9, wherein said first means includes a bolt means disposed through a threaded bolt hole formed through said handle means and opening on said bore, whereby disposing a portion of said shaft means proximate said first end within said bore and tightening said bolt means adjustably fastens said handle means to said shaft means.

12. The racket sport training device as claimed in Claim 1, further comprising a weight adjustably attached to said shaft means, whereby the balance of said training aide may be varied by disposing said weight along various positions along said shaft means.

13. The racket sport training device as claimed in Claim 2, further comprising means for monitoring the efficiency of said stroke.

14. The racket sport training device as claimed in Claim 13, wherein said means for monitoring includes; a revolution meter including a second shaft means and a housing having a digital display for indicating the number of revolutions of said second shaft means; third means attaching said housing to a second

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end of said first shaft means; and fourth means attaching said second shaft means to said member; whereby as said member follows said flat, vertical surface, said second shaft is caused to spin for a number of revolutions determined by the efficiency of said stroke.

15. A racket sport training device as claimed in Claim 14, wherein said revolution meter includes: a transducer means in said housing, whereby said transducer means converts rotary motion of said second shaft means relative to said housing into an electrical signal; and an output means responsive to said electrical signal and operative to produce on said display an indication of the efficiency of said stroke.

16. A racket sport training device as claimed in Claim 15, wherein said transducer means includes a generator.

17. A racket sport training device as claimed in Claim 16 wherein said output means includes a light emitting device operative to emit light having an intensity functionally related to the voltage level of said electrical signal.

18. A racket sport training system comprising: a first member including, an elongated shaft means, a handle means attached proximate a first end of said shaft means, and a surface following means attached proximate a second end of said shaft means; and surface forming means provided with at least one flat, vertical surface, whereby a person who grasps said handle, disposes said surface following means against said flat, vertical surface and swings through an imaginary birdie or ball, is guided through a correct racket stroke.

19. A racket sport training system as claimed in Claim 18, wherein said surface forming means includes; a base portion disposed upon a flat, horizontal surface, post means rising substantially perpendicularly from said base portion, a backboard means provided with said flat, vertical surface, and means attaching said backboard means is positioned above said base means so that a player can dispose said surface following means

-14-

against said flat, vertical surface to practice over-
head and underhand strokes.



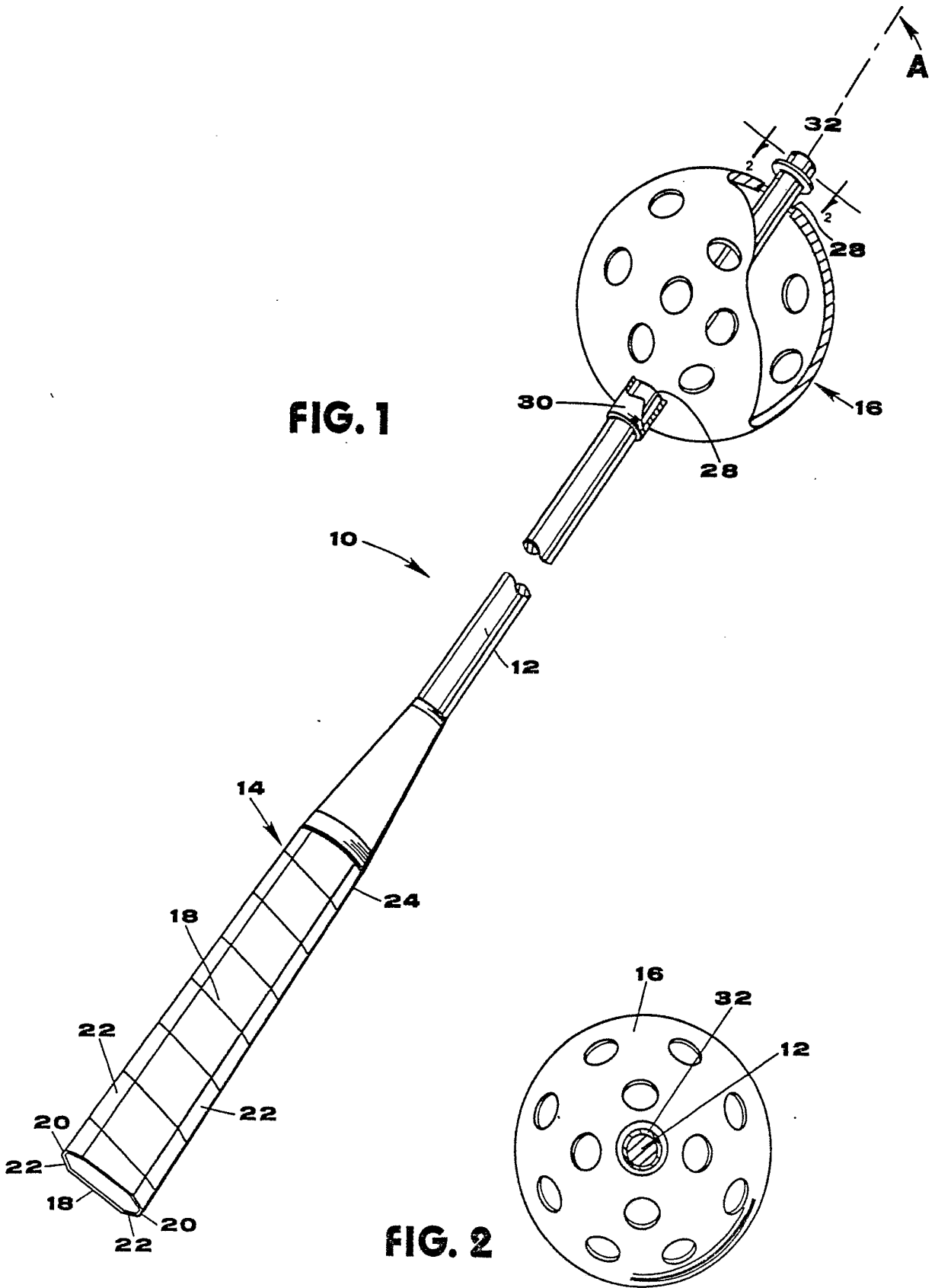


FIG. 1

FIG. 2

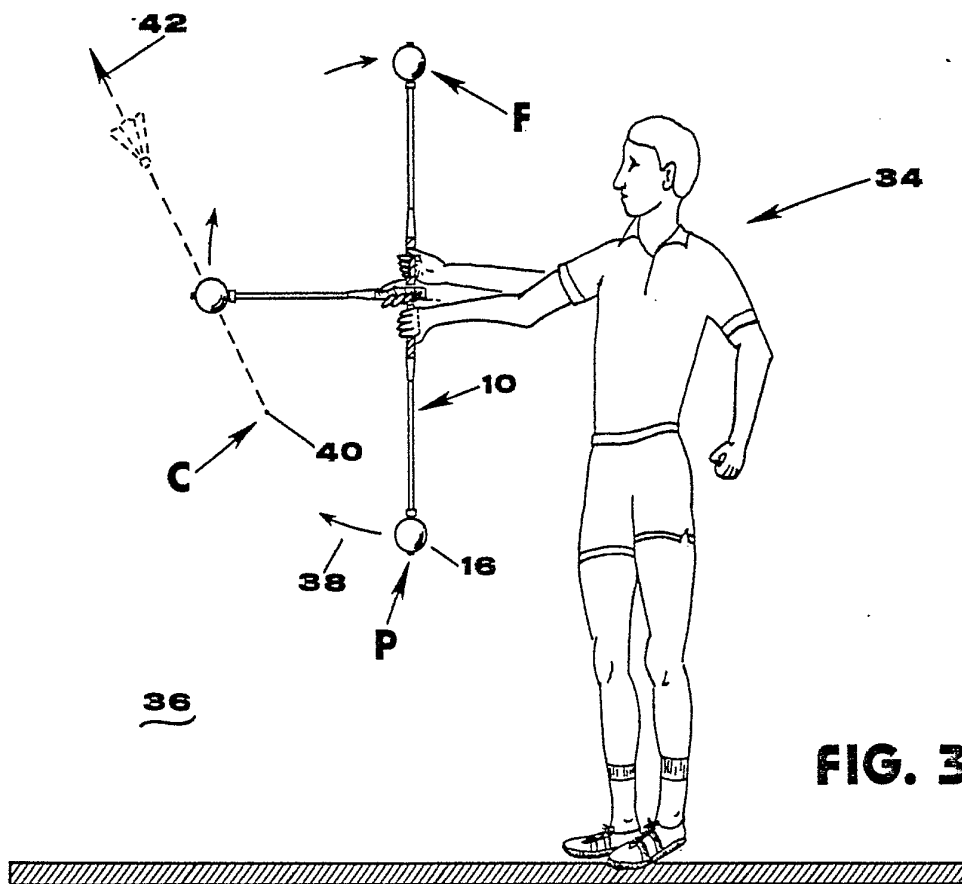


FIG. 3

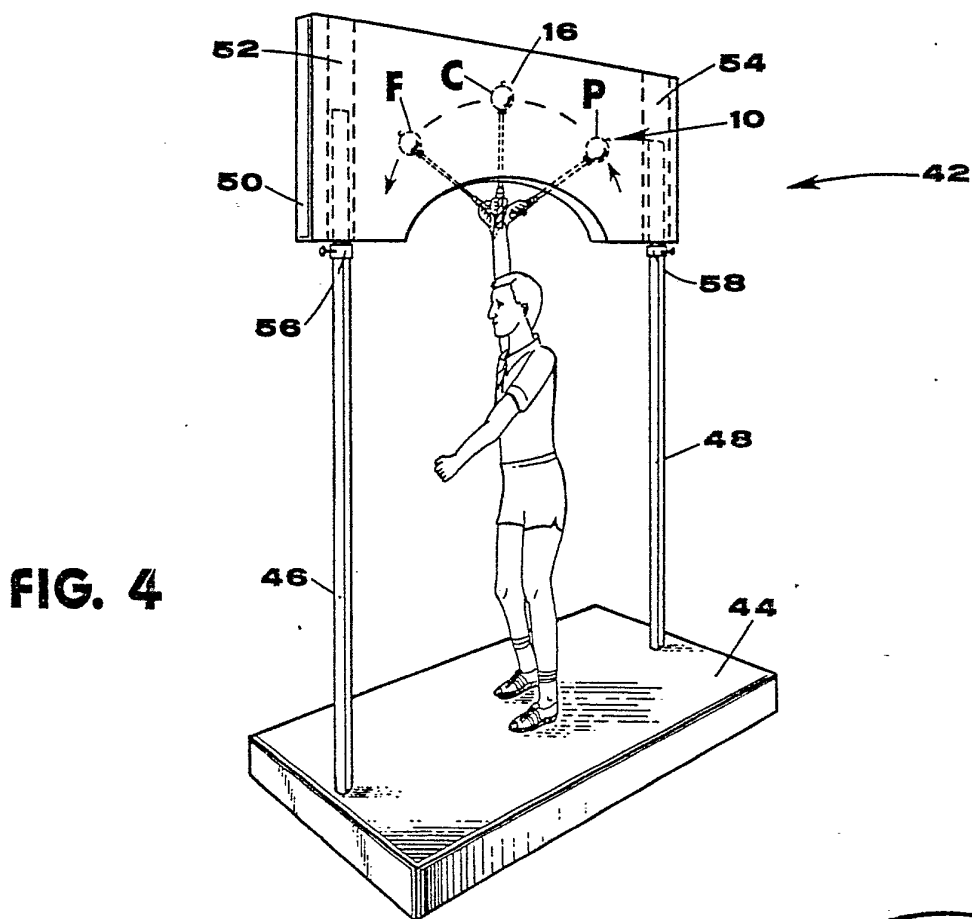


FIG. 4

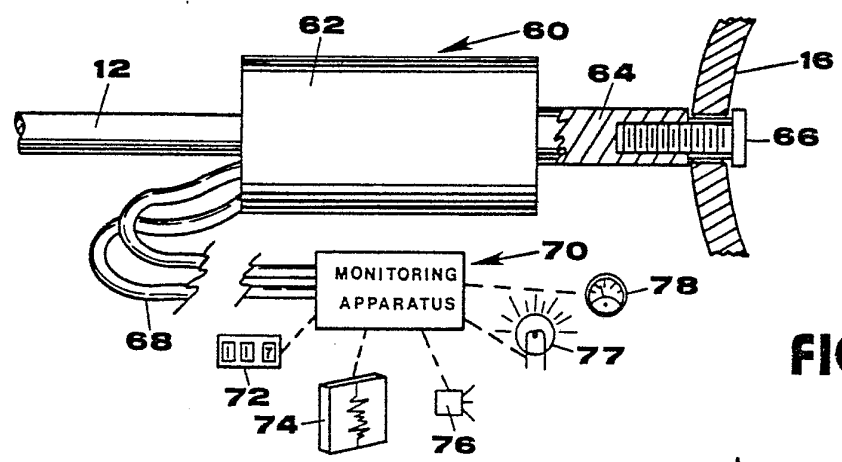


FIG. 5

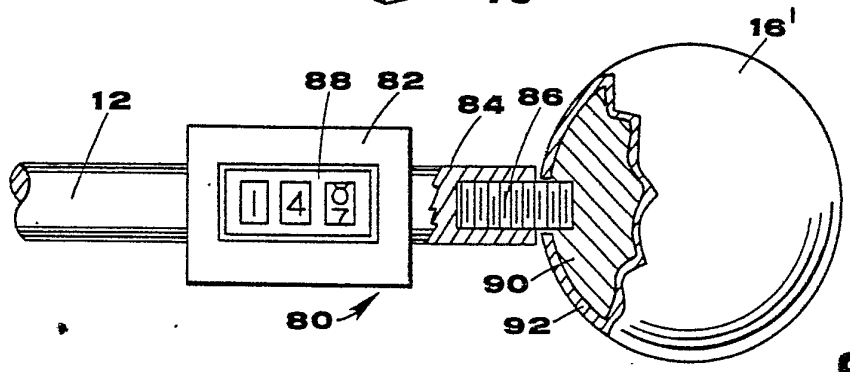


FIG. 6

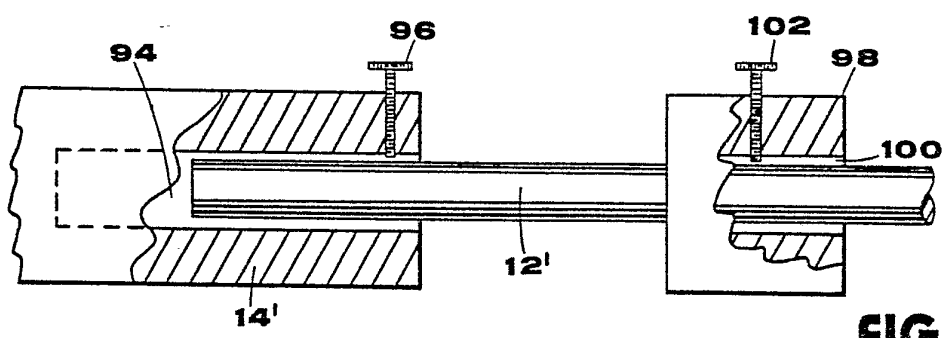


FIG. 7

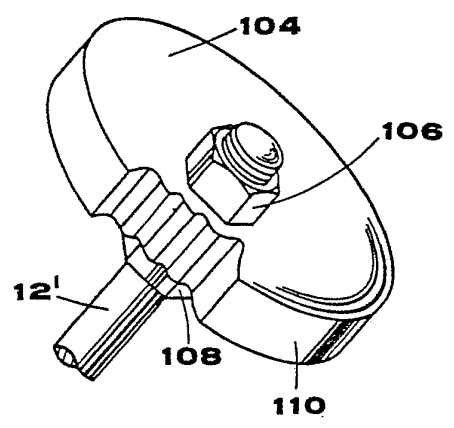


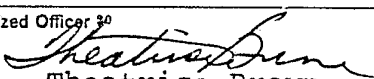
FIG. 8

INTERNATIONAL SEARCH REPORT

International Application No

PCT/US79/00433

Wo 80/00062

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ³		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int. Cl. A63B 69/36, 69/38; A63B 71/02; A63B, 49/08 U.S. Cl. 273/186A, 29A; 124/5		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁴		
Classification System	Classification Symbols	
US	273/26, 29, 35, 186, 191, 73J, 95H 124/5	
Documentation Searched other than Minimum Documentation to the extent that such Documents are included in the Fields Searched ⁵		
III. DOCUMENTS CONSIDERED TO BE RELEVANT ¹⁴		
Category [*]	Citation of Document, ¹⁵ with indication, where appropriate, of the relevant passages ¹⁷	Relevant to Claim No. ¹⁸
A	US, A, 3,845,953, Published 05 November 1974, Malhas	1-18
A	US, A, 3,997,159, Published 14 December 1976, Malhas	1-18
A	US, A, 4,027,879, Published 07 June 1977, Wright	1-3, 9, 10, 18, 19
A	US, A, 3,897,058, Published 29 July 1975, Koch	1-18
X	US, A, 2,135,648, Published 08 November 1938, Stumpf	1-3, 10, 18, 19
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X	US, A, 3,136,546, Published 09 June 1964 Connolly	1, 9, 10, 18, 19
X	US, A, 2,705,148, Published 29 March 1955, Waller	1-4, 7, 9, 10, 18, 19
(Continued on Supplemental Sheet 2)		
* Special categories of cited documents: ¹⁶		
"A" document defining the general state of the art		"P" document published prior to the international filing date but on or after the priority date claimed
"E" earlier document but published on or after the international filing date		"T" later document published on or 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
"L" document cited for special reason other than those referred to in the other categories		"X" document of particular relevance
"O" document referring to an oral disclosure, use, exhibition or other means		
IV. CERTIFICATION		
Date of the Actual Completion of the International Search ²	Date of Mailing of this International Search Report ²	
20 September	02 OCT 1979	
International Searching Authority ¹	Signature of Authorized Officer ²⁰	
ISA/US	 Theatrice Brown	

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

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A	CH, A 604,761, Published 15 September 1978, Maurer (Switzerland)	1-4,9,10, 18,19

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers, because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. Claim numbers, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this international application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the International application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

- The additional search fees were accompanied by applicant's protest.
 No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM THE SECOND SHEET

III		
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X	US,A, 3,351,346, Published 07 November 1967, Strahan	1,8
X	US,A, 3,931,968, Published 13 January 1976, Hedberg	1,11
X	US,A, 3,861,688, Published 21 January 1975, Butler	13,14,17

V. OBSERVATIONS WHERE CERTAIN CLAIMS WERE FOUND UNSEARCHABLE ¹⁰

This international search report has not been established in respect of certain claims under Article 17(2) (a) for the following reasons:

1. Claim numbers, because they relate to subject matter ¹² not required to be searched by this Authority, namely:

2. Claim numbers, because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out ¹³, specifically:

VI. OBSERVATIONS WHERE UNITY OF INVENTION IS LACKING ¹¹

This International Searching Authority found multiple inventions in this International application as follows:

1. As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims of the international application.

2. As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims of the international application for which fees were paid, specifically claims:

3. No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claim numbers:

Remark on Protest

The additional search fees were accompanied by applicant's protest.

No protest accompanied the payment of additional search fees.