

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
21 April 2011 (21.04.2011)

PCT

(10) International Publication Number
WO 2011/044642 A1

(51) International Patent Classification:

A63B 71/02 (2006.01) A63B 71/06 (2006.01)
A63B 63/00 (2006.01)

(21) International Application Number:

PCT/AU2010/001381

(22) International Filing Date:

18 October 2010 (18.10.2010)

(25) Filing Language:

English

(26) Publication Language:

English

(30) Priority Data:

2009905050 16 October 2009 (16.10.2009) AU

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(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM,

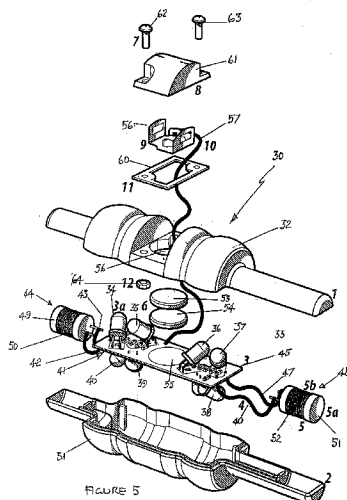
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: SYSTEM FOR INDICATING MOVEMENT OF AN ARTICLE FROM ONE POSITION OR ORIENTATION TO ANOTHER POSITION OR ORIENTATION



(57) Abstract: An assembly for indicating movement of an article used in a sporting activity from a first position or orientation to a second position or orientation, the second position or orientation indicating an event during game or sports play which relates to or influences a game or sport outcome, the system comprising: a electrical circuit associated with the article and including means enabling detection of a displacement of the article responsive to a trigger event; the circuit including a power source, sensing means responsive to the trigger event and which activates an indicator allowing an observer to detect movement of the article the instant it moves to the second position.

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SYSTEM FOR INDICATING MOVEMENT OF AN ARTICLE FROM ONE
POSITION OR ORIENTATION TO ANOTHER POSITION OR ORIENTATION

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BACKGROUND

The present invention relates to an assembly for detection of movement of an article relative to another object such as in a sporting event in which detection of an event measured by the article movement determines an outcome which influences the result of the sporting activity. More particularly and more broadly, the invention relates to an indicating system for indicating movement of an article from one position or orientation to another position or orientation with the movement indicating to an observer an event occurrence. The invention further relates to a system which allows umpire detection of an event which influences a game or sport activity outcome. More particularly the invention provides a visual or audible indication of an event in which an article used as game equipment is displaced such as deflection of a boundary marker or when a bail is separated from a cricket stump. The invention further relates to an indicating system in which when used in cricket enables a visual and/or audible indication of separation of a bail from a cricket stump. The present invention more particularly relates to a bail including inbuilt electronics which enables cricket umpires and the like to detect dismissal of a batsman by separation of a bail from cricket stumps.

PRIOR ART

25 Sporting events including team sports are played extensively throughout the world. In each sport there is an objective to be achieved and rules which govern conduct of the sport. Detection of events which can determine a game outcome is essential. These can be determined by an umpire, video referees and electronic devices such as those used in tennis tournaments. When umpires are the determinant of occurrence of an event which can determine a game outcome such as when a player is out of the playing field, a game objective has been achieved or a player is given out, human error can occur. This can adversely influence a game outcome. It is essential that

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rules and judgments based on those rules are applied accurately to avoid unfairness to players. In recent times there has been a trend towards use of electronic aids in umpiring to remove human error from decision making.

5 Cricket is played in a number of countries throughout the world including in Australia, South Africa, New Zealand, England, West Indies, India, Pakistan and Sri Lanka. As with many sports umpiring is imperfect resulting in errors which can effect the outcome of a game. Video replays have been employed to enable umpires to view repeats of the game activity and particularly when a player has been given out or when there is doubt as to whether a player remains in our out.

10 In the game of cricket a player can be dismissed by a run out. This is an event where a batsman is caught out of the batsman's crease during running between the wickets by an opposing player making contact with the stumps with the bail. A player is out when the bails leave the supporting stumps. A batsman can also be given out when a ball hits the wicket during a play – i.e, once a ball has been delivered. Also, at any
15 time, a player on an opposing side can 'stump' a batsman by hitting the stumps with the ball and dislodging the bails, if and when the batsman is caught outside the crease.

Run outs are difficult decisions for umpires as the umpire must accurately determine whether the bails have lifted before a batsman places the bat on the crease line after running between wickets. Bails dislodging, is a sign that the ball has hit the stumps.
20 It can be difficult for umpires to ascertain the precise moment that bails leave the cricket stumps before falling on the ground. If a bail is dislodged from the stumps, but does not fall to the ground, this does not result in dismissal of a player. However, where a bail falls on the ground and a player can be given out, it is helpful to know the precise moment when the bail leaves the stumps. Mistakes have occurred in
25 cricket dismissals where players are declared out when they should not have been or are not declared out when they should have been. This leads to controversy and lack of confidence in referees. In recent years cricket officials have turned to video replays to ascertain if a player is out or not.

There is a long felt want in the industry to provide more efficient and accurate
30 methods of indicating events incident to game play which must be accurate and which

have an impact on the game outcome when bails leave stumps so that errors in dismissals can be eliminated from the game.

There is also a long felt want in the industry to provide a more efficient method of indicating when bails leave stumps so that errors in dismissals can be eliminated from the game.

INVENTION

The present invention provides an assembly for detection of movement of an article relative to another object such as in a sporting event in which detection of an event measured by the article movement determines an outcome which influences the result of the sporting activity. The invention further provides an indicating system for indicating movement of an article from one position or orientation to another position or orientation with the movement indicating to an observer an event occurrence. The invention further provides a system which allows umpire detection of an event which influences a game or sport activity outcome. The invention further provides a visual or audible indication of an event in which an article used as game equipment is displaced such as deflection of a boundary marker or when a bail is separated from a cricket stump. The present invention also provides a bail including inbuilt electronics which enable cricket umpires and the like to detect dismissal of a batsman by separation of a bail from cricket stumps.

Although the invention will be predominantly described with reference to its application in the game of cricket, and specifically its use in a cricket stump or in bails, it will be recognised by persons skilled in the art that the invention has other applications beyond those to be described below such as but not limited to, its use in other sports to detect movement of such articles as corner posts in football and /or rugby. For instance, the invention can be adapted to indicate displacement of a corner post to indicate that a player is outside the playing field. In that case an indicator light sound or other indicating signal would indicate when a sideline has been breached.

In one broad form the present invention comprises:

a system for indicating movement of an article used in a sporting activity from a first position or orientation to a second position or orientation, the second position or

orientation indicating an event during game or sports play which relates to or influences a game or sport outcome, the system comprising:

a electrical circuit associated with the article and including means enabling detection of a displacement of the article responsive to a trigger event;

- 5 the circuit including a power source, sensing means responsive to the trigger event and which activates an indicator allowing an observer to detect movement of the article the instant it moves to the second position.

According to one embodiment the article is a corner post on a playing field and the second position results from a displacement of the corner post from a vertical position
10 indicating that a player has touched the field boundary.

According to an alternative embodiment the article is a cricket bail which is supported by cricket stumps.

In another broad form the present invention comprises:

a cricket bail comprising;

- 15 a body including a wall defining an internal space;

the bail including integrally attached indicating means to indicate when a separation between the bail and a supporting stump occurs during play.

In another broad form the present invention comprises:

- 20 an assembly for indicating movement of an article used in a sporting activity from a first position or orientation to a second position or orientation, the second position or orientation indicating an event during the sporting activity which influences an outcome of the sporting activity, the assembly comprising:

a electrical circuit associated with the article and including means enabling detection of a displacement of the article responsive to a trigger event;

- 25 the circuit including a power source, wherein the means enabling detection of a displacement of the article responsive to the trigger event activates an indicator

allowing detection of movement of the article the instant it moves from the first position.

In another broad form the present invention comprises:

5 a cricket bail comprising;

a body including a wall defining an internal space;

a first support arm extending from a first end of the body and a second support arm extending from a second end of the body;

10 means on at least one of said support arms which engage a saddle in or on a stump which supports the bail when in use;

means in the bail for providing an indication to an observer when at least one said support arms breaks contact with the saddle.

15 According to a preferred embodiment, the indicating means is located in an internal space inside the bail. The indicating means may comprise but is not limited to a transmitted signal, an alarm, a light and/or a sound such as a buzzer, beeper, siren or bell, any of which indicate a separation of contact of one or both of the support arms from the stump saddle.

20 According to a preferred embodiment, the cricket bail is manufactured in plastics from a mould and is formed by opposing housing elements which when coupled comprise a wall defining an internal space. The bail is at least partially hollow and preferably houses a printed circuit board including at least one high intensity LED which are powered by batteries. Preferably, the wall of the bail is either transparent or opaque but preferably transparent to disperse light emitting from inside the bail. Preferably the LED's are variously angled from the plane of circuit board to disperse
25 light in multiple directions. The circuitry includes at least one and preferably two inductors which regulate light intensity. In use, when bail housing elements are engaged to from the finished bail, a support arm engages a metallic saddle in the stump which opens the circuit. In the event of bail displacement between the support

arm and the metallic saddle a change in inductance is detected resulting in illumination of the LED's thereby providing an indication that a cricket player has been stumped or bowled.

5 As an alternative to the light indications, the bail may be adapted with a sound emitting device or means to transmit a condition signal to an observer who may for instance be an umpire on the field or in a remote location. An umpire may for instance have an ear piece which receives an audible sound to indicate a separation of the bail from the stump. A separation condition may be transmitted via a hard wire, radio wave, infrared, blue tooth or other form of signal to a remote receiving device. For 10 instance, a bail separation condition may be indicated on a remote television screen display. The indication of bail separation may also be useful to reduce or avoid the instinct of a batsman given out by an umpire, to question the ruling. This is particularly so in the event of a stumping or run out.

15 In another broad form the present invention comprises:

a method for indicating that a cricket bail has separated from a supporting cricket stump, the method comprising the steps of;

- a) providing a bail having a body including a wall defining an internal space and extending from the body first and second support arms;
- 20 b) providing inside the bail an electrical circuit including a power source, light and/or sound emitting means;
- c) providing a contact on at least one support arm for the bail which engages a metallic contact on a supporting stump;
- d) providing indicating means in or on the bail to indicate to an observer when at 25 least one said support arms of the bail breaks contact with the stump saddle.

In another broad form the present invention comprises:

an assembly for indicating a separation between a cricket stump and a bail having a body including a wall defining an internal space and extending from the body first and second support arms;

5 an electrical circuit inside the bail including a power source, light and/or sound emitting means;

means on at least one support arm for the bail which engages a metallic element on a supporting stump;

10 the light and /or sound emitting means providing an indication in or on the bail to indicate to an observer when at least one said support arms of the bail displaces from a metal contact on the stump. According to a preferred embodiment the means on the support arm is a sensor which co operates with the metallic element. The bails and stumps may be hollow or solid. According to one embodiment the assembly is operated using inductance. In an alternative embodiment, an electrical contact is used to trigger indication of a predetermined event.

15 The present invention provides an alternative to the known prior art and the shortcomings identified. The foregoing and other objects and advantages will appear from the description to follow. In the description reference is made to the accompanying representations, which forms a part hereof, and in which is shown by way of illustration specific embodiments in which the invention may be practiced.

20 These embodiments will be described in sufficient detail to enable those skilled in the art to practice the invention, and it is to be understood that other embodiments may be utilized and that structural changes may be made without departing from the scope of the invention. In the accompanying illustrations, like reference characters designate the same or similar parts throughout the several views. The following detailed
25 description is, therefore, not to be taken in a limiting sense, and the scope of the present invention is best defined by the appended claims.

BRIEF SUMMARY OF DRAWINGS

The present invention will now be described according to a preferred but non limiting embodiment and with reference to the accompanying illustrations, wherein:

- Figure 1** shows an elevation view of abbreviated cricket stumps supporting two bails according to a typical arrangement.
- Figure 2** shows a plan view of the arrangement of figure 1.
- 5 **Figure 3** shows an exploded view of the stumps of figure 1 with bails isolated therefrom.
- Figure 4** shows the stumps of figure 3 partially re assembled.
- Figure 5** shows an exploded view of a bail according to a preferred embodiment and adapted with electronics to enable instant indication of a separation from supporting stumps.
- 10 **Figure 6** shows a cross sectional elevation of a cricket stump and bales assembly according to a preferred embodiment with electronics incorporated inside the bales.
- Figure 7** shows a perspective exploded view of a bail and indicating assembly according to an alternative embodiment.
- 15 **Figure 8** shows an enlarged view of the inertia spring and contact pin of the assembly of figure 7.
- Figure 9** shows a side elevation view of the assembly of figure 7 fully assembled.
- 20 **Figure 10** shows an end view of the assembly of figure 9.
- Figure 11** shows a long sectional view through a line B-B of figure 10; and
- Figure 12** shows a cross section through a line A-A shown in figure 9.
- 25 **Figure 13** shows a perspective exploded view of a bail and indicating assembly according to an alternative embodiment.
- Figure 14** shows an enlarged view of the inertia spring and contact pin of the assembly of figure 13.
- 30 **Figure 15** shows a side elevation view of the assembly of figure 13 fully assembled.
- Figure 16** shows an end view of the assembly of figure 15.
- 35 **Figure 17** shows a long sectional view through a line B-B of figure 10; and
- Figure 18** shows a cross section through a line A-A shown in figure 15.
- Figure 19** shows an exploded view of a bail assembly including a movement indicating circuit according to an alternative embodiment.

- Figure 20** shows an exploded view of the bail assembly including a movement indicating circuit according to an alternative embodiment.
- 5 **Figure 21** shows the bail assembly of figures 19 and 20 fully assembled for use.
- Figure 22** shows an exploded view of the batteries and printed circuit boards.
- Figure 23** shows the printed circuit boards and batteries fully assembled.
- 10 **Figure 24** shows an exploded view of the LED Array and mounting member.
- Figure 25** shows an opposite side view of the mount member of figure 24.
- Figure 26** shows side by side an LED of a first size and an abbreviated LED.
- 15 **Figure 27** shows plan and side elevation views of the LED array in the mounting member.

20 DETAILED DESCRIPTION

The present invention obviates the disadvantages of the prior art and provides other advantages which are apparent from the description herein.

25 Although the present invention will be described with reference to its application in the game of cricket, it will be appreciated by persons skilled in the art that the assembly to be described below according to various embodiments may be adapted for use in other applications. For instance, an article can be attached to another article such as a corner post so that when a player strikes the corner post, the article is dislodged and transmits a signal to another location to enable an umpire to
30 adjudicate on an event which may influence a game. An article could also be attached to a goal post to indicate when a goal or try has been scored.

Figure 1 shows an elevation view of abbreviated cricket stumps and bails assembly 1 comprising stumps 2, 3 and 4. Stumps 2, 3 and 4 terminate at one end
35 in ground engaging points 5, 6 and 7 and at an opposite end respective supporting saddles 8, 9 and 10 which collectively receive and support bails 11 and 12 according to a typical arrangement.

Figure 2 shows a plan view of the arrangement of figure 1 with corresponding numbering. Bail 11 comprises a main body 13 and extending from opposite ends respective support arms 14 and 15 which respectively engage saddles 9 and 8. Bail 12 comprises a main body 16 and extending from opposite ends respective support arms 17 and 18.

Figure 3 shows an exploded view of the stumps 2, 3 and 4 of figure 1 with bales isolated therefrom. Stumps 2 and 3 are conventional solid bails. Stump 3 is hollow. Hollow bails have in the past been used for stump cams which are when used embedded in the middle stump. Stump 3 comprises a hollow body 20 which receives and retains removable cap 21 via threaded region 22. Cap 21 includes a recess 23 which receives and retains therein a saddle element 24. Access to hollow interior 25 allows opportunity for installation of electronics as required. **Figure 4** shows the stumps 2, 3 and 4 of figure 3 partially re assembled with cap 21 inserted into hollow body 20.

Figure 5 shows an exploded view of a bail 30 according to a preferred embodiment which is adapted with electronics to enable when in use, instant indication of a separation from supporting stumps. According to the embodiment shown, bail 30 is formed by moulded opposing housing elements 31 and 32. Housing elements 31 and 32 are preferably manufactured in plastics from a mould. At least part of bail 30 so formed from elements 31 and 32 is either transparent or opaque but preferably transparent to disperse light emitting from inside the bail. Housed in bail 30 is an electronic printed circuit board 33 from which depend a plurality of preferably high intensity LED's 34, 35, 36, 37, 38 and 39 and 40 which are variously angled from the plane of circuit board 33. Extending from end 41 of circuit board 33 are wires 42 and 43 which terminate at inductor 44. Extending from opposite end 45 are wires 46 and 47 which terminate in inductor 48. Inductor 44 has a ferrite drum core 49 around which is wound copper coil 50. Likewise inductor 48 has a ferrite drum core 51 around which is wound copper coil 52. The LED's are powered by batteries 53 and 54 which locate in recess 55 of board 33. Batteries 53 and 54 engage contact 56 via electrical wire 57. Contact 56 locates in recess 58 of bail element 32. Opening 59 is sealed by seal 60 when formation 61 locates in recess 58 of bail element 32. Formation 61 locates in

recess 58 to complete the required bail shape and is secured by fasteners 62 and 63 co operating with nuts 64 and 65 (obscured). Circuit board 33 locates in recess 66 of body 67 in bail element housing 31. Body 67 terminates in end recess 68 which receives and retains therein inductor 44. Likewise at opposite end of body 67 there is provided a recess 69 which receives and retains therein inductor 48. In use, when bail elements 31 and 32 are engaged to form bail 30 support arm 70 engages metallic saddle 24 as shown in figure 4.

With the inductors 44 and 48 in the circuit as shown, the LED's have higher resistance than the inductor coils which have much lower resistance. When the circuit is initially powered the LED's glow. When the circuit is opened, the lights shine very brightly and then quickly go out. This is due to the inductors initially providing a high resistance until a magnetic field is built up at which time the inductors provide less resistance taking current away from the lights which travels through the inductors which by now are low resistance. When current first starts flowing in the inductor coils, the coils build up a **magnetic field**. While the magnetic field is building, the coils inhibit the flow of current. Once the magnetic field is built up, current can flow normally through the wire. This is typical inductor operation. The present invention employs an inductive loop including an inductive sensor to detect any change of inductance. When a change of inductance is detected, the LED light triggers. Each bail has an inductive loop in each arm. A metal pellet in each bail when the bail moves causes a change in inductance, triggering the indicating light. When the stump is placed under the inductive loops in the bails, the bail senses the inductance and monitors the inductance regularly. When the metal saddle in the stump is moved away from the inductive loops, such as by removal of the bails, the bail senses a change in inductance and the LEDs flash for a few seconds and then preferably turn off to save power. The initial 3 seconds of the lighting sequence may involve the lights being in a steady on condition whereupon they may revert to a flashing condition for the remaining 4 seconds to save power. The advantage of the steady on indicator light is to maximise the light output as the bail leaves the stump while the decision regarding whether a player is out is contentious. After the bail has separated significantly, the flashing provides a power saving, as well as an exciting visual effect that is appealing to spectators.

Although detection of change of inductance is the preferred method for actuation of the indicator, other methods may be used such as:

- 1 Optical (visible and IR)
- 5 2 Contact switch
- 3 Pressure switch (eg: Membrane switch)
- 4 Electro Magnetic Resonance
- 5 Tilt Switch
- 6 Accoustic sensor
- 10 7 Capacitive sensor
- 8 Resistive sensor
- 9 Inertial switch.

Inductive sensors are preferred as they have a number of advantages over the above methods. For instance they are less prone to false readings due to rain, vibration, dirt or grass on the stump saddle and they can be completely sealed. Recharging of batteries can be done inductively through the inductor coil with a special recharger, like a battery powered tooth brush. The sensitivity can be adjusted to avoid a hair trigger effect that produces false readings from vibrations due to wind or footsteps. Typically, the LEDs trigger when the bail is separated from the stump saddle by approx 1mm (non limiting).

Figure 6 shows with numbering corresponding to figure 5, a cross sectional elevation of a stumps 2, 3 and 4 and bails 80 and 81 adapted with the printed circuit board 33 of figure 5. The arrangements are the same for bail 81 as for bail 80 so for convenience, only bail 80 will be described and numbered.

Bail 80 is preferably made to two moulded halves 82 and 83. These halves engage each other to form an internal space in which circuit board 33 from which depend a plurality of preferably high intensity LED's 34, 35, 36, 37, 38 and 39 and 40 which are variously angled from the plane of circuit board 33. Extending from end 41 of circuit board 33 are wires 42 and 43 which terminate at inductor 44. Extending from opposite end 45 are wires 46 and 47 which terminate in inductor 48.

Contact 56 is shown located in recess 84 of bail element 82. Opening 59 is sealed by seal 60 when formation 61 locates in recess 84. In use, when bail element 82 and 83 are engaged to form bail 80, support arm 85 engages metallic saddle 24 as shown in figure 4.

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According to one embodiment the invention described herein may be used to detect boundary line contact in a sport having a defined playing field such as cricket. Typically, triangular advertising segments are placed over the rope, providing padding to prevent rope burn to the player, but also, providing advertising sponsorship for TV broadcasts. Sometimes the fielder slides into the boundary rope to flick the ball back onto the field. The player must flick the ball back and release contact with the ball before making contact with the rope. This is similar to a run out described earlier where an off field umpire is asked to adjudicate two things simultaneously from slowed down footage. In the case of boundary contact detection, the present invention will identify the precise moment that contact is made with the boundary rope to determine if that is before or after contact with the ball is released. Presently, the body of the player often obstructs a view of the point of contact with the rope. If contact with a segment of boundary rope creates an illumination on contact, the umpires can make accurate judgements as to whether the batsman has scored 4 runs or not. Similarly use of the present invention in a corner post will enable the umpire/referee to determine when a corner post has been contacted. In an alternative embodiment, the assembly of the invention is adapted for use in a cricket stump rather than the bails in which case means for indication and the associated electronics would be located in the bails. According to this embodiment coils are introduced in to the stumps and a metal plate is placed in the bail spigots.

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Figure 7 shows a perspective exploded view of an indicating assembly 90 according to an alternative embodiment. According to the embodiment shown there is provided a printed circuit board (PCB) 91 which retains thereon batteries 92 providing a source of power. A series of inertia switches may be used but in this case there is provided one inertia switch 96. Inertia switch 96 is arranged to operate in three dimensions to allow detection of movement in any plane of movement. One switch is shown but the number of switches selected can be varied

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according to requirements. PCB 91 is contained within a bail housing 97. Bail housing 97 is shown in two parts 97a and 97b and when assembled terminates in spigots 98 and 99. In this embodiment, the bail housing spigots do not have a proximity sensor.

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The inertia switch can typically operate such that on impact spring 100 makes contact with the pin 101 opening the circuit. The pin 101 is preferably soldered to the printed circuit board 91. The spring 100 is also soldered to the printed circuit board. In an alternative embodiment, a combination of three inertia switches can be used to detect a shock/displacement in three axes - X, Y and Z. Bail spigots 98 and 99 can be either solid or hollow with no proximity sensor required. Preferably, there is provided at least one inertia switch. Type B would suffice otherwise a combination of C and B or a single device that would trigger in 3 Axes A. Assembly 90 includes a removable battery cover A which locates inside housing 97. Cover A retains a battery contact B having positive and negative poles which engage battery 92. The printed circuit board and the battery contact B connects the batteries 92 other positive and negative terminals. Battery cover A clips into a recess in the bail housing C. Battery 92 locates in respective recesses 104 of housing part 97b and recess 105 of housing part 97a. Parts 97a and 97b are ultrasonically welded together so that opposing surfaces D engage to form housing 97. Included on printed circuit board are LED's 93, 94 and 95 which are actuated once motion switch 96 opens the circuit. The LED's provide an immediate indication of a separation between the bail spigots 99 or 98.

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Figure 8 shows an enlarged view of the inertia spring 100 and contact pin 101 of the assembly of figure 7. The circuit is activated when spring 100 contacts pin 101. **Figure 9** shows with corresponding numbering a side elevation view of the assembly of figure 7 fully assembled. **Figure 10** shows with corresponding numbering an end view of the assembly of figure 9.

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Figure 11 shows with corresponding numbering a long sectional view through a line B-B of figure 10. Bail housing 97 is shown in two parts 97a and 97b and when assembled terminates in spigots 98 and 99. Printed circuit board 91 is located along a midline of housing 97 and retains battery 92 which is itself retained by cover A which urges contact B into contact with battery 92. A series of inertia

switch 96 is arranged to operate in three dimensions to allow detection of movement in any plane of movement. Impact spring 100 makes contact with the pin 101 opening the circuit when movement is detected. The pin 101 is preferably soldered to the printed circuit board 91. The spring 100 is also soldered to the printed circuit board. Bail spigots 98 and 99 are hollow but these can be solid. Cover A retains a battery contact B having positive and negative poles which engage battery 92. Battery cover A clips into a recess in the bail housing C. **Figure 12** shows with corresponding numbering a cross section through a line A-A shown in figure 9.

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The aforesaid arrangement could be used for a toy or simply as a shock sensing bail.

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Figure 13 shows a perspective exploded view of a bail and indicating assembly according to an alternative embodiment. The fundamental difference between the assembly of figures 7-12 and that of figures 13 – 18 (see below) is that housing 97 has been abbreviated by removal of spigots 98 and 99. In their place is are two flexible outer covers 102 and 103 which include spigots 99 and 98. Covers 102 and 103 provide shock absorbers and are mounted over housing 97. Included on printed circuit board are LED's 93, 94 and 95 which are actuated once motion switch 96 opens the circuit. The LED's provide an immediate indication of a separation between the bail spigots 99 or 98. **Figure 14** shows an enlarged view of the inertia spring and contact pin of the assembly of figure 13. **Figure 15** shows a side elevation view of the assembly of figure 13 fully assembled. **Figure 16** shows an end view of the assembly of figure 15. **Figure 17** shows a long sectional view through a line B-B of figure 10. From this view it can be seen that covers 102 and 103 envelop cover 97 so it acts as an outer cover. **Figure 18** shows a cross section through a line A-A shown in figure 15. Covers 102 and 103 are preferably moulded from a clear plastics material such as an elastomer for shock absorption and light transmission.

Figure 19 shows an exploded view of a bail assembly 110 including a movement indicating circuit assembly 130 according to an alternative embodiment. Assembly 110 comprises a housing 111 comprising two parts 112

and 113. Housing 111 includes spigots 114 and 115 which when the bail is in use will seat on a stump (not shown). Part 112 includes recess 116 and part 113 includes recess 117. Recesses 116 and 117 comprise a space in which circuit assembly 130 is located. Clamp assemblies 118 and 119 secure circuit assembly 130 in position. Once the bail is assembled adhesive tapes 120, 121 and 122 can be used to reinforce the housing 111.

Circuit assembly 130 includes a gang of printed circuits boards 123, which engage button batteries 124, 125 and 126. Circuit boards 123 terminate in positive and negative terminals 127 and 128. Circuit boards 123 are preferably soldered with electrical connection pins. Contact bridge 129 secures the batteries to the printed circuit boards 123 and prevents them dislodging. Circuit assembly 130 comprises inductor coils 131 and 132 which are responsive to movement of bail 110. Coil 131 is linked via wires 134 to an LED array 137 and thence to the battery power source via wires 138. A flexible shock absorber 139 assists in dissipating energy shocks imparted to assembly 110. Coil 132 is linked via wires 140 to an LED array 141 and thence to the battery power source via wires 142. A flexible shock absorber 143 assists in dissipating energy shocks imparted to assembly 110. Circuit 130 further comprises a capacitor 144 useful for blocking direct current while allowing alternating current to pass.

Figure 20 shows an exploded view of the bail assembly 110 including a movement indicating circuit 130 according to an alternative embodiment. The essential difference between the embodiment of figure 19 and that of figure 20 is that in the latter, the clamping assemblies 118 and 119 have been set into respective recesses 116 and 117. **Figure 21** shows with corresponding numbering, the bail assembly 110 of figures 19 and 20 fully assembled for use.

Figure 22 shows with corresponding numbering an exploded view of the batteries 124, 125 and 126 and printed circuit board array 123. Terminals 127 and 128 define a recess in which batteries are located. **Figure 23** shows the printed circuit boards and batteries fully assembled. **Figure 24** shows an exploded view of the LED Array 141 separated from mounting member 150 which are in axial

alignment along axis 151. **Figure 25** shows an opposite side view of the mount member 150 of figure 24. Mount member 150 includes a fin 160 which acts as a light baffle to absorb ambient light transmitted through the bail. **Figure 26** shows side by side an LED 152 of a first size and an abbreviated LED 153. LED 153
5 may be ground down to conserve space.

Figure 27 shows plan and side elevation views of the LED array 150 in the mounting member 141. It can be seen from the side elevation view of mount 141 that openings 154 which receive the LED array 150 are disposed along angled axis
10 156 which allow the light to be directed.

It will be recognised by persons skilled in the art that numerous variations and modifications may be made to the invention described herein without departing from the overall spirit and scope of the invention.

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THE CLAIMS DEFINING THE INVENTION ARE AS FOLLOWS:

1. An assembly for indicating movement of an article used in a sporting activity, from a first position or orientation to a second position or orientation, the second
5 position or orientation indicating an event during the sporting activity which influences an outcome of the sporting activity, the assembly comprising:

a electrical circuit associated with the article and including means enabling detection of a displacement of the article responsive to a trigger event;

the circuit including a power source, wherein the means enabling detection of a
10 displacement of the article responsive to the trigger event activates an indicator allowing detection of movement of the article the instant it moves from the first position.
2. An assembly according to claim 1 wherein the article co operates with a support member so that the second position is a result of the article moving relative to
15 the support member.
3. An assembly according to claim 2 wherein, the electrical circuit, power source and indicator are retained in a protective housing.
4. An assembly according to claim 3 wherein the means enabling detection of a displacement of the article is a sensor.
- 20 5. An assembly according to claim 4 wherein, when the article moves, the sensor activates a signal which provides an indication of a separation between the article and the support member.
6. An assembly according to claim 5 wherein the trigger event is an impact load which causes the article to at least partially displace relative to the support member
- 25 7. An assembly according to claim 6 wherein the trigger event is an impact load which causes the support member to move to cause the article to at least partially displace, relative to the support member

8. An assembly according to claim 7 wherein, the article comprises a cricket bail and the support member comprises a supporting cricket stump
9. Assembly according to claim 7 wherein, the trigger event is enabled by contact between a ball and a cricket stump
10. An assembly according to claim 9 wherein, the indicating means for transmission of the signal is an alarm.
11. An assembly according to claim 9 wherein, the indicating means for transmission of the signal is a light such as an LED.
12. An assembly according to claim 9 wherein, the indicating means for transmission of the signal is a sound emitting device selected from a buzzer, beeper, siren or bell.
13. An assembly according to claim 7 wherein, the article is supported by a boundary line marker
14. An assembly according to claim 13 wherein, the boundary marker is a corner post on a sporting field.
15. An assembly according to claim 14 wherein the second position of the article results from a displacement of the corner post from a vertical position indicating that there is a separation between the article and corner post when a player has touched the post.
16. An assembly according to claim 15 wherein, the trigger event is a person contacting a boundary line.
17. An assembly according to claim 16 wherein, the indicating means for transmission of the signal is an alarm
18. An assembly according to claim 17 wherein, the indicating means for transmission of the signal is a light.

19. An assembly according to claim 18 wherein the indicating means for transmission of the signal is a sound emitting device selected from a buzzer, beeper, siren or bell.
20. An assembly according to claim 6 wherein, the article is supported by a goal post
21. An assembly according to claim 19 wherein, the trigger event is a ball passing a predetermined location on a goal post.
22. An assembly according to claim 9 wherein the housing includes a detachable cover which retains positive and negative battery contacts.
- 10 23. A cricket bail including an assembly for indicating movement of the bail during a sporting activity from a first position or orientation to a second position or orientation, the second position or orientation indicating an event during the sporting activity which influences an outcome of the sporting activity, the bail comprising;
- a body including a wall defining an internal space;
- 15 the bail including self contained indicating means to indicate when a separation between the bail and a supporting stump occurs during play.
24. A cricket bail according to claim 23 further comprising indicating means which triggers a signal indicating the separation between the bail and a supporting cricket stump when the bail is subject to an impact.
- 20 25. A cricket bail according to claim 24 further comprising;
- a first support arm extending from a first end of the body and a second support arm extending from a second end of the body;
- means on at least one of said support arms which engage a saddle in or on a stump which supports the bail when in use;
- 25 means in the bail for providing an indication to an observer when at least one said support arms breaks contact with the saddle.

26. An article including an internal assembly for indicating movement of the article when used in a sporting activity from a first position or orientation to a second position or orientation relative to another member, the second position or orientation indicating an event during the sporting activity which influences an outcome of the sporting activity,
27. An article according to claim 26 wherein the indicating means is located in an internal space inside the bail and indicates a separation of contact of one or both of the support arms from the stump saddle.
28. A article according to claim 27 wherein, the article is a cricket bail which is manufactured in plastics from a mould .
29. A article according to claim 28 wherein, the bail is formed by opposing housing elements which when coupled comprise a wall defining an internal space.
30. A bail according to claim 29 wherein, the bail is at least partially hollow and preferably houses a printed circuit board.
31. A bail according to claim 30 further comprising at least one high intensity LED powered by batteries.
32. A bail according to claim 31 wherein, the wall of the bail is transparent to disperse light emitting from inside the bail.
33. A bail according to claim 32 wherein, the LED's are variously angled from the plane of circuit board to disperse light in multiple directions.
34. A bail according to claim 33 wherein, the circuitry includes at least one and preferably two inductors which regulate light intensity.
35. A bail according to claim 34 wherein, the bail housing elements are engaged to form the finished bail.
36. A bail according to claim 35 wherein a support arm engages a metallic saddle in the stump which opens the circuit.

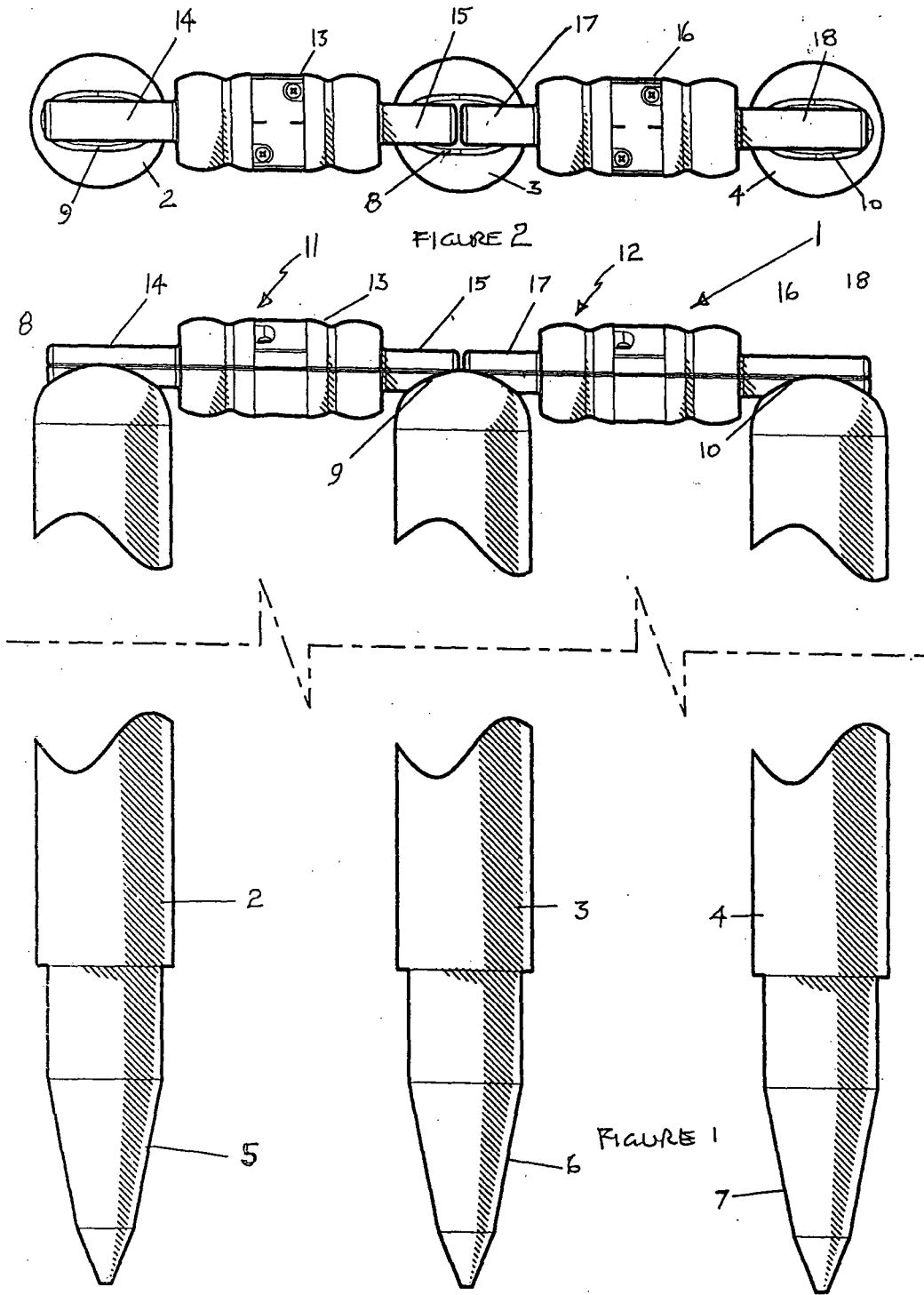
- 37 A bail according to claim 36 wherein, in the event of bail displacement between the support arm and the metallic saddle a change in inductance is detected resulting in illumination of the LED's thereby providing an indication that a cricket player has been stumped or bowled.
- 5 38. A bail according to claim 37 wherein, a signal indicating a separation between the bail and the stump is transmitted to a remote receiving device.
39. A bail according to claim 38 wherein, the signal indicating a separation between the bail and the stump is transmitted to the remote receiving device via means selected from a hard wire, radio wave, infrared or blue tooth.
- 10 40. A bail according to claim 39 wherein, the remote receiving device which indicates a separation between the bail and the stump is a television receiver.
41. an assembly for indicating a separation between a cricket stump and a bail having a body including a wall defining an internal space and extending from the body first and second support arms;
- 15 an electrical circuit inside the bail including a power source, light and/or sound emitting means;
- means on at least one support arm for the bail which engages a metallic element on a supporting stump;
- the light and /or sound emitting means providing an indication in or on the bail to
- 20 indicate to an observer when at least one said support arms of the bail displaces from a metal contact on the stump.
42. An assembly according to claim 41 wherein the means on the support arm is a sensor which co operates with the metallic element.
43. An assembly according to claim 42 wherein the bails and stumps are hollow.
- 25 44. An assembly according to claim 43 wherein, the assembly is operated using inductance.

45. A method for indicating that a cricket bail has separated from a supporting cricket stump, the method comprising the steps of;

- a) providing a bail having a body including a wall defining an internal space and extending from the body first and second support arms;
- 5 b) providing inside the bail an electrical circuit including a power source, light and/or sound emitting means;
- c) providing a contact on at least one support arm for the bail which engages a metallic contact on a supporting stump;
- 10 d) providing indicating means in or on the bail to indicate to an observer when at least one said support arms of the bail breaks contact with the stump saddle.

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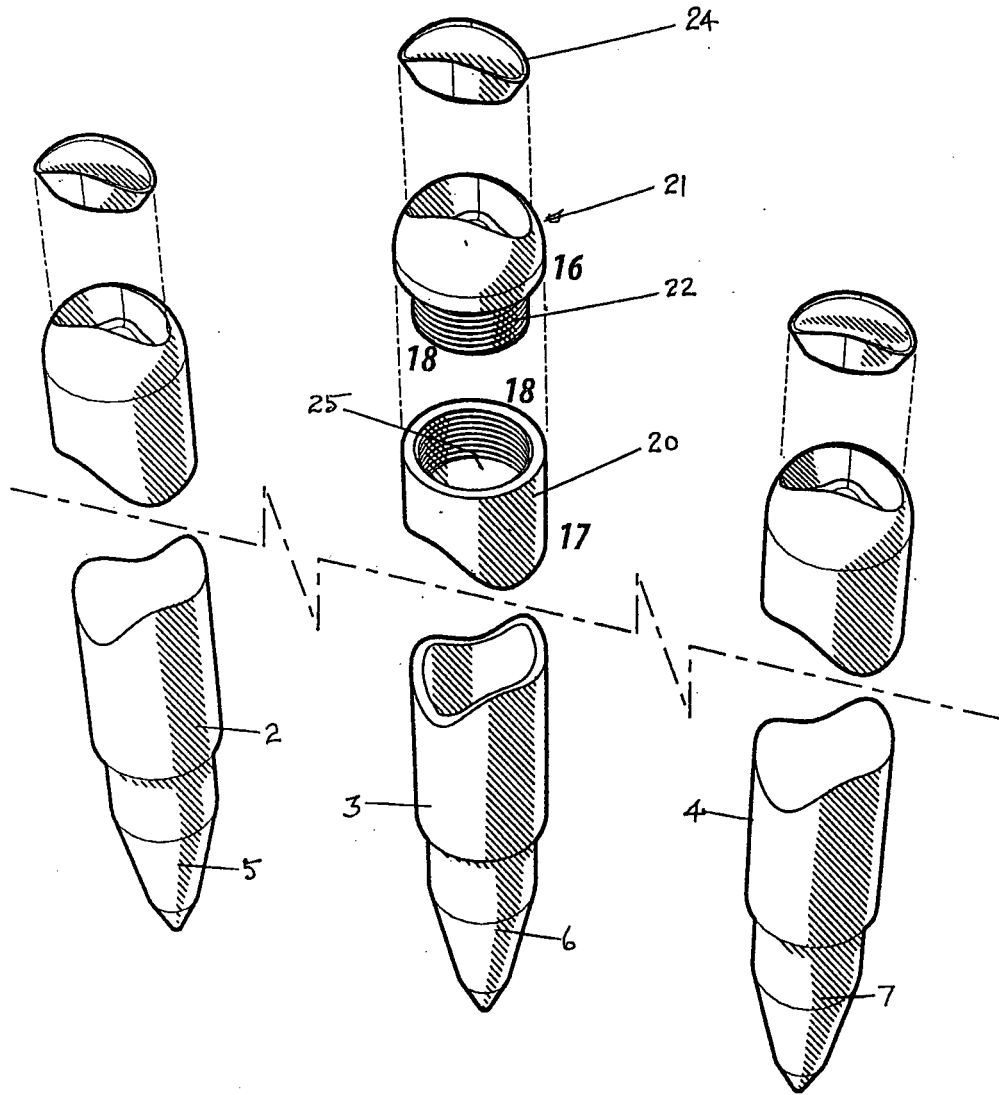


FIGURE 3

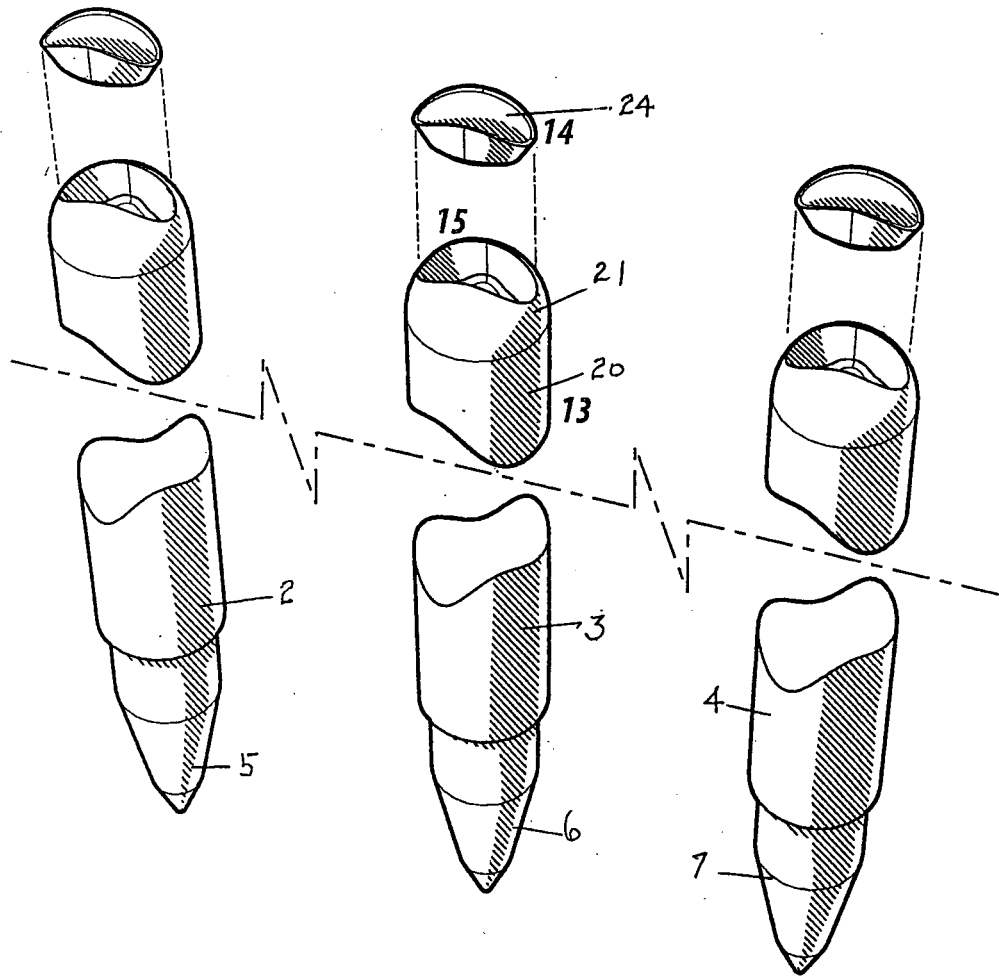


FIGURE 4

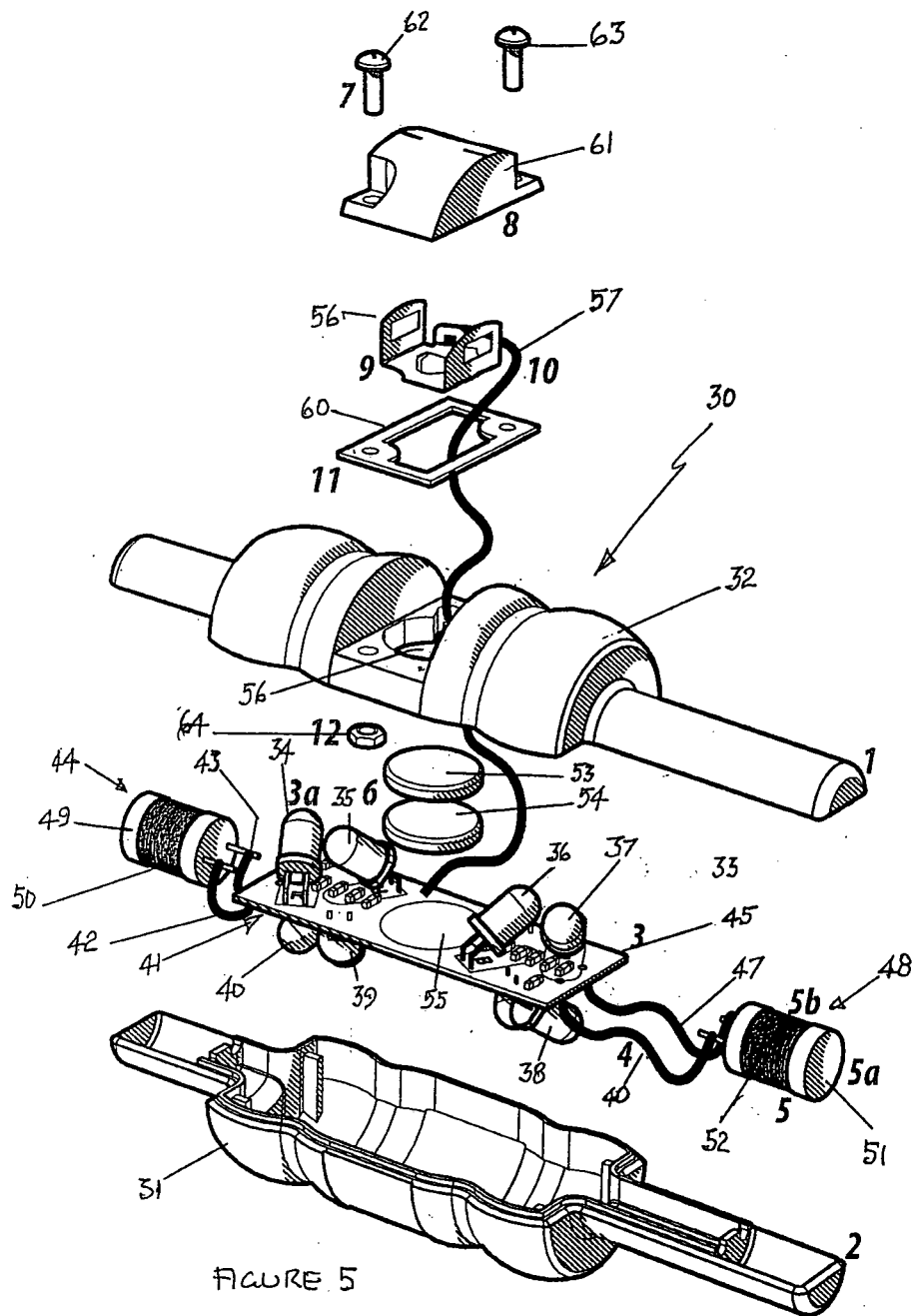
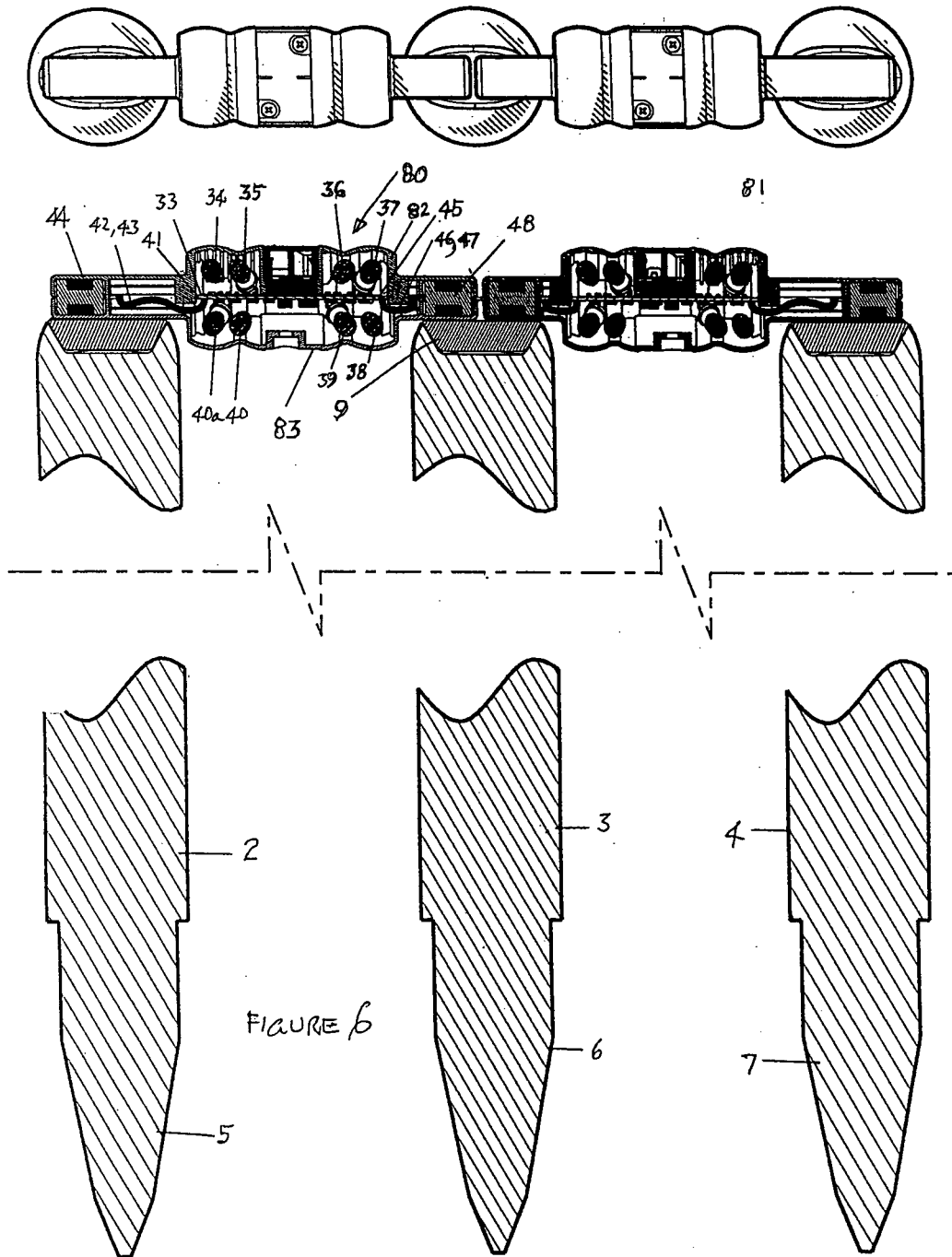


FIGURE 5



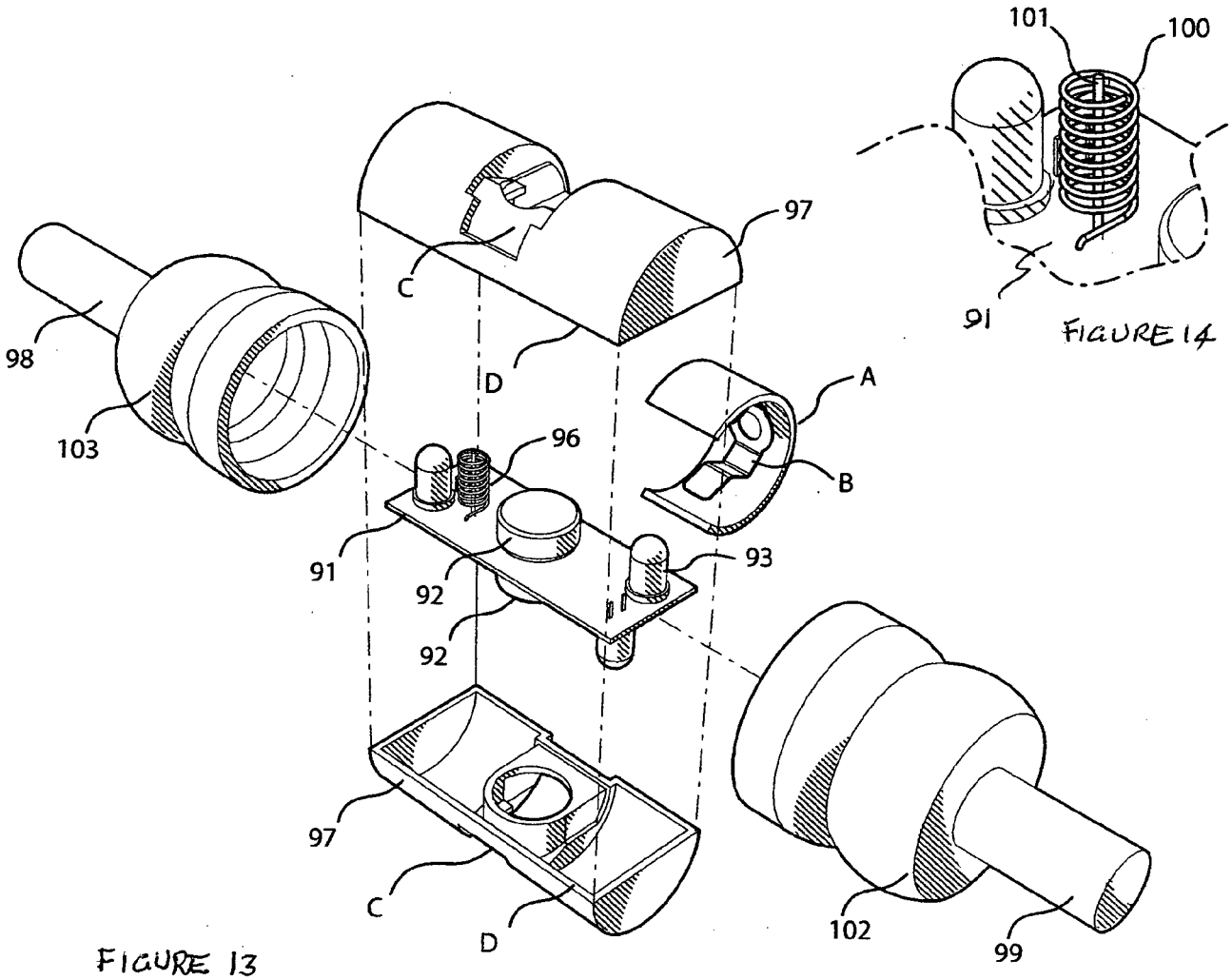


FIGURE 13

FIGURE 14

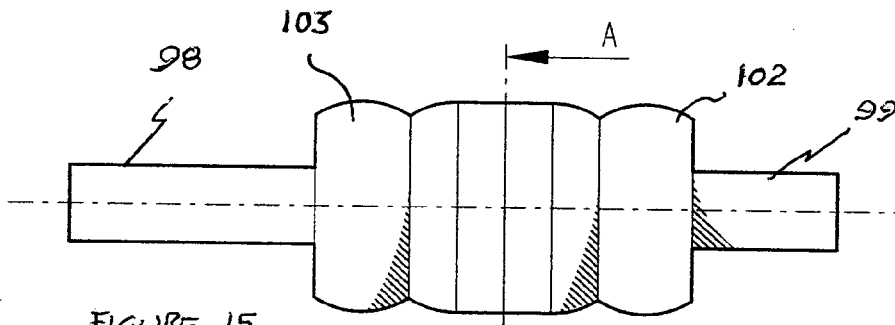


FIGURE 15

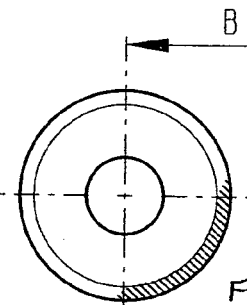
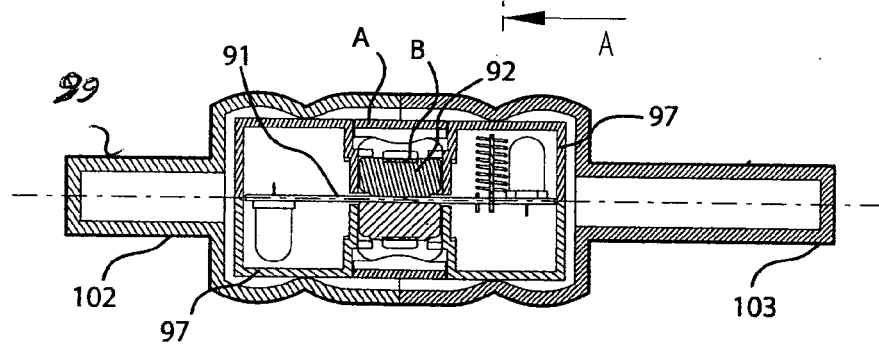
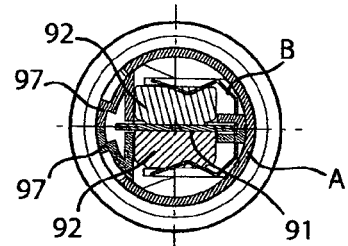


FIGURE 16



SECTION B-B

FIGURE 17



SECTION A-A
FIGURE 18

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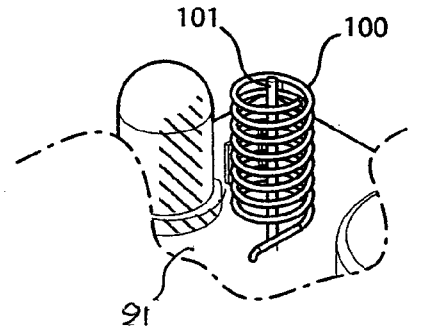
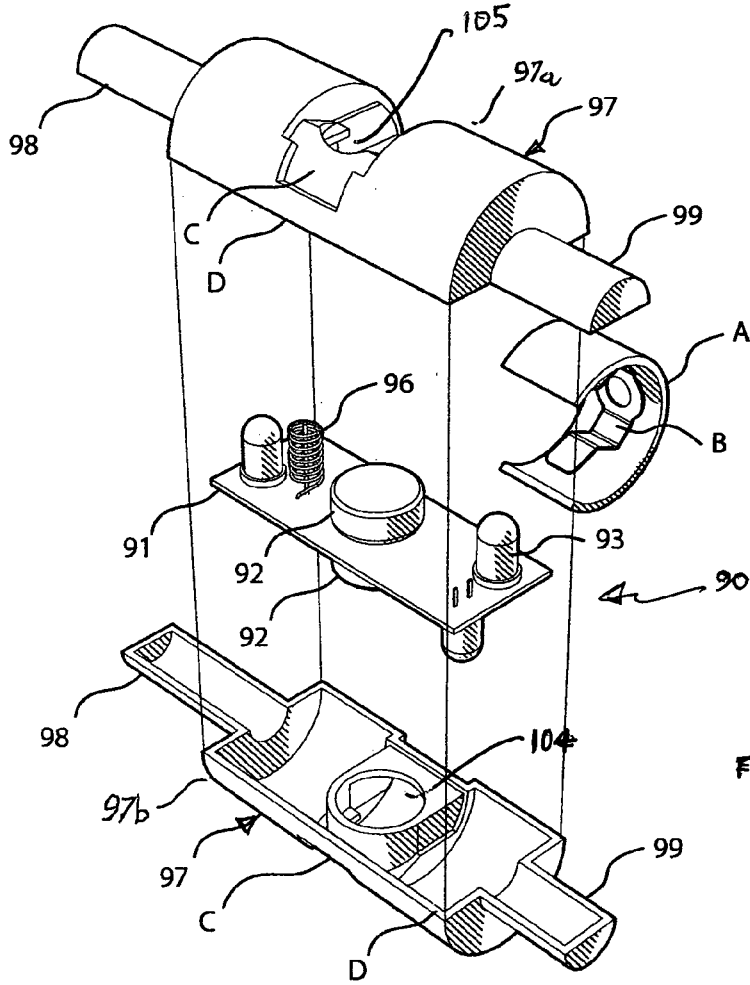


FIGURE 8

FIGURE 7

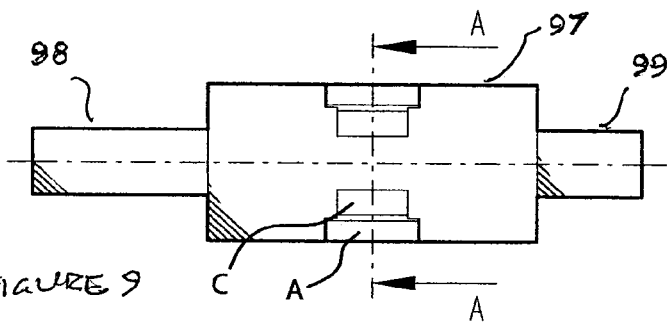


FIGURE 9

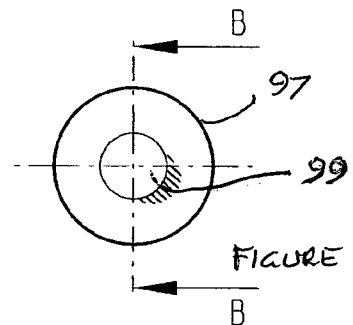
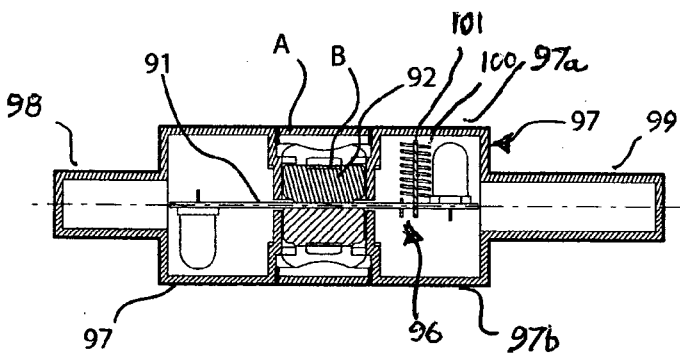
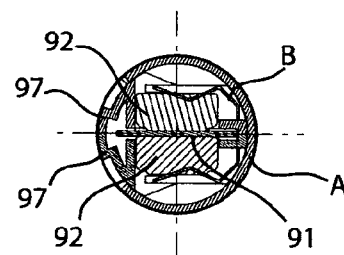


FIGURE 10



SECTION B-B

FIGURE 11



SECTION A-A

FIGURE 12

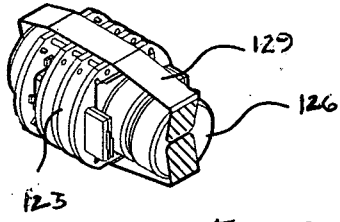


FIGURE 23

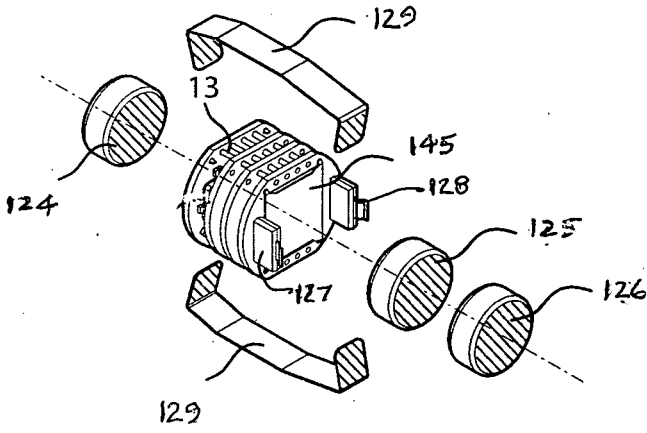


FIGURE 22

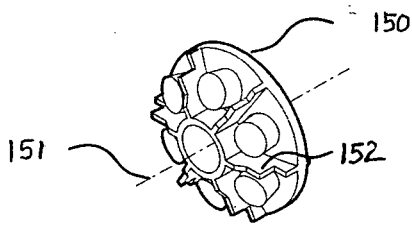


FIGURE 25

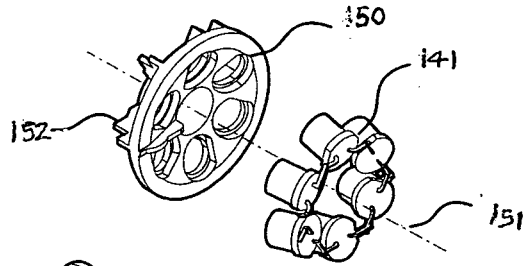


FIGURE 24

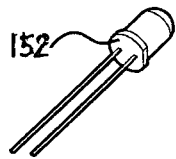


FIGURE 26

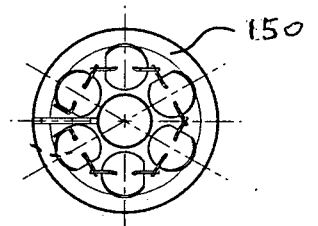
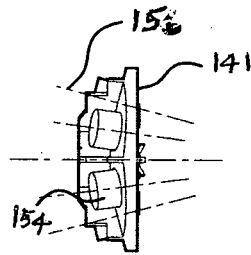


FIGURE 27

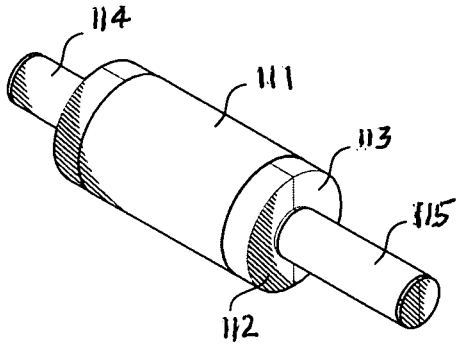


FIGURE 21

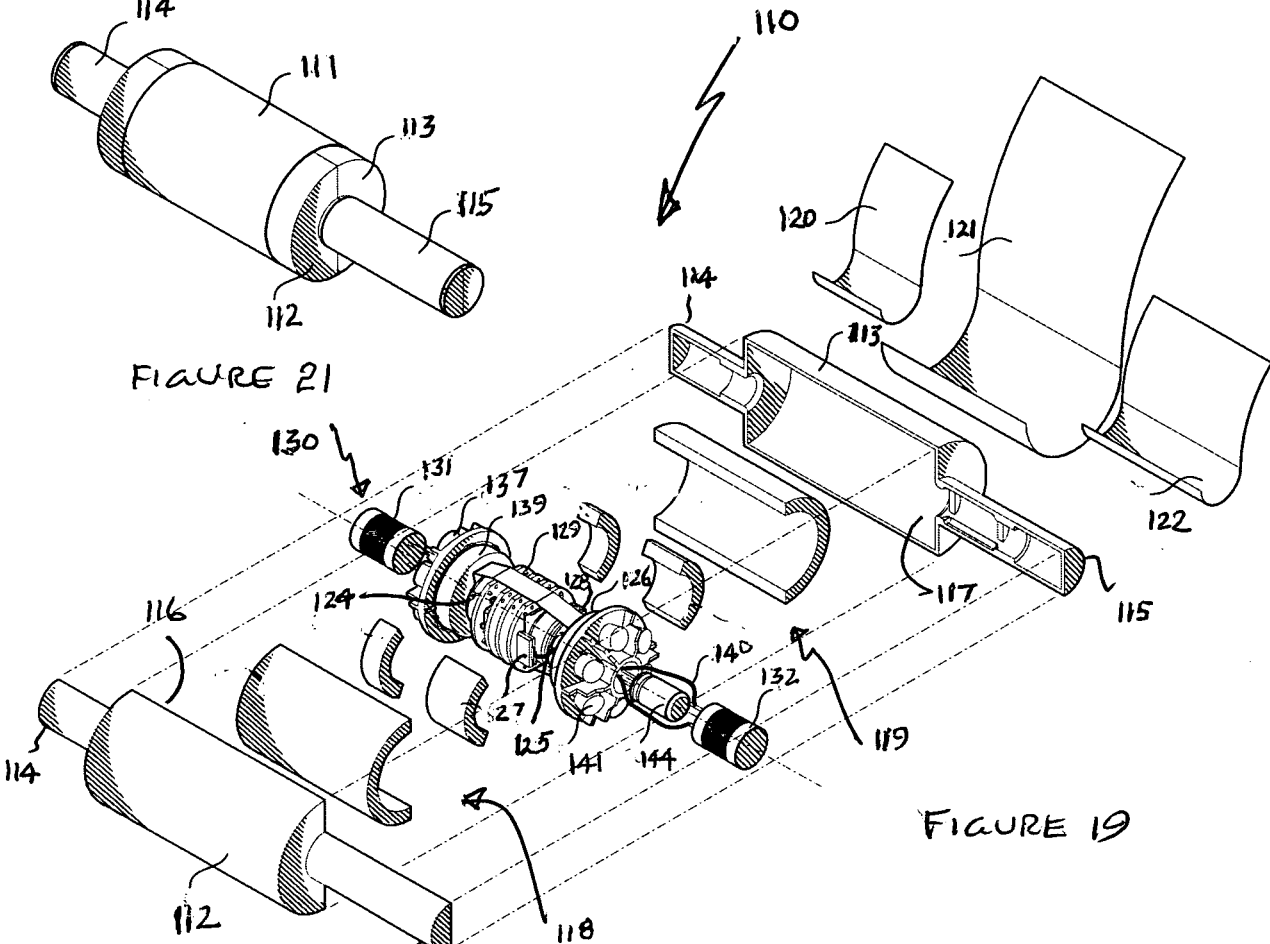


FIGURE 19

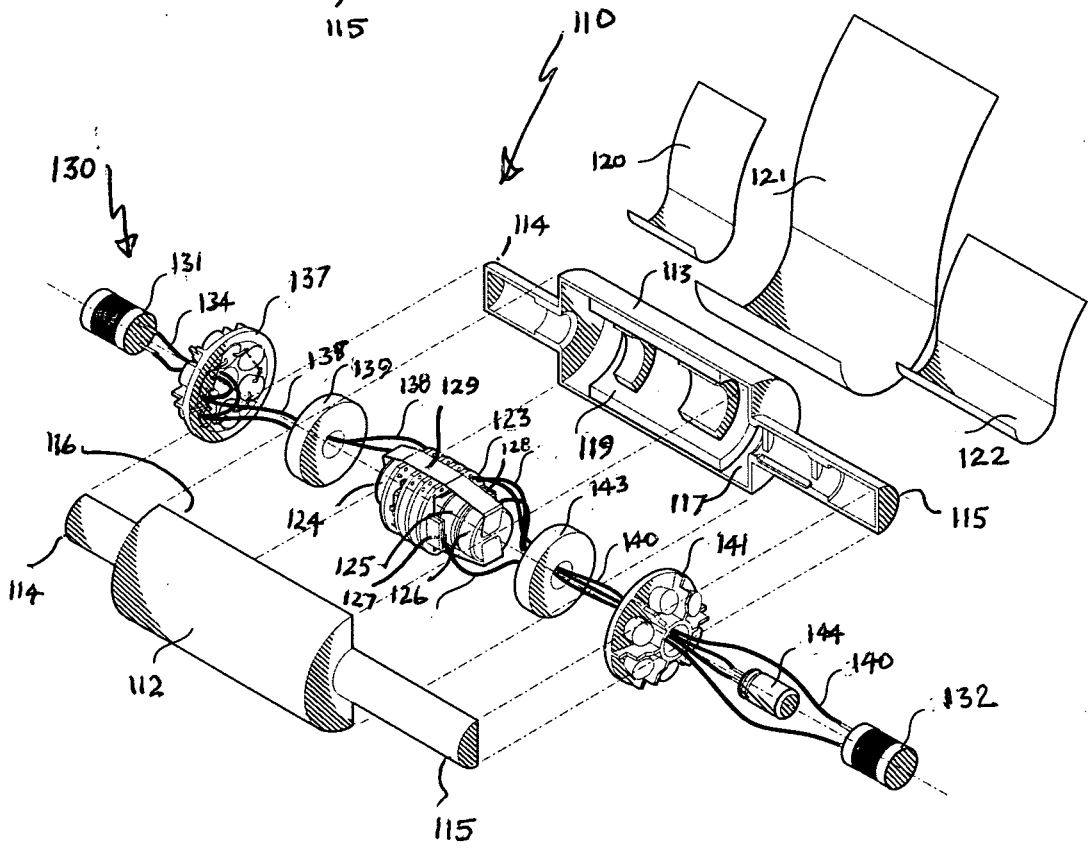


FIGURE 20

INTERNATIONAL SEARCH REPORT

International application No.

PCT/AU2010/001381

A. CLASSIFICATION OF SUBJECT MATTER		
Int. Cl.		
A63B 71/02 (2006.01) A63B 63/00 (2006.01) A63B 71/06 (2006.01)		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols)		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) AusPat, Esp@ce, Google, Google Scholar, EPODOC, WPI (cricket, sport, athletic, displace, detect, alert, alarm etc...)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2003/033081 A2 (EICHSTADT) 24 April 2003 Abstract, figures 1 and 3, page 1 lines 28-31, page 2 lines 9-12, page 3 lines 5-6, page 8 lines 10-11	1-10, 12, 20, 22, 26
A	GB 2341555 A (INTELLIGENT SPORTS TECHNOLOGY Ltd) 22 March 2000 Entire document	1-45
<input type="checkbox"/> Further documents are listed in the continuation of Box C <input checked="" type="checkbox"/> See patent family annex		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "E" earlier application or patent but published on or after the international filing date "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "O" document referring to an oral disclosure, use, exhibition or other means "&" document member of the same patent family "P" document published prior to the international filing date but later than the priority date claimed		
Date of the actual completion of the international search 15 December 2010		Date of mailing of the international search report 07 JAN 2011
Name and mailing address of the ISA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustalia.gov.au Facsimile No. +61 2 6283 7999		Authorized officer ANDREW ELLETT AUSTRALIAN PATENT OFFICE (ISO 9001 Quality Certified Service) Telephone No : +61 2 6225 6120

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/AU2010/001381

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
WO	03033081	AU	2002348214	ZA	200402715
GB	2341555	NONE			

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX