Aug. 30, 1966 T. R. MORRISON 3,269,729

POSITION CONTROL APPARATUS WITH FLEXIBLE LEVEL INDICATOR AND MOUNTING STRAP

Filed Feb. 24, 1964

FIG. 1

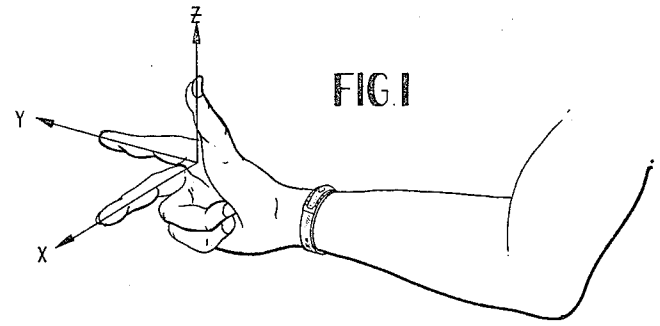


FIG. 2

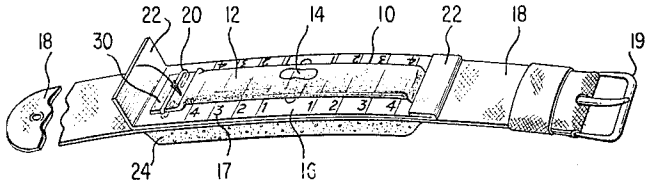


FIG. 5

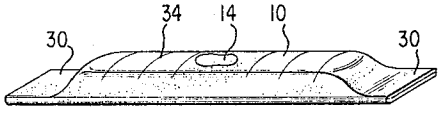


FIG. 3

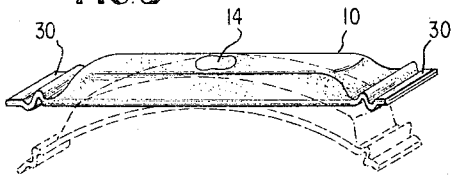


FIG. 6

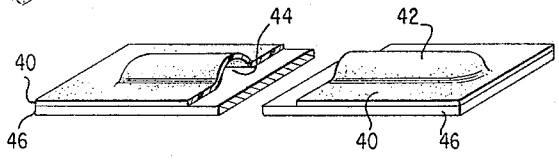


FIG. 4

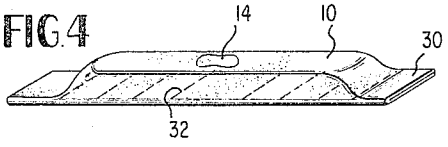
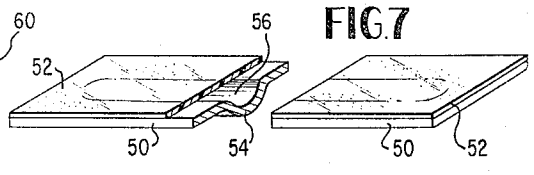


FIG. 7



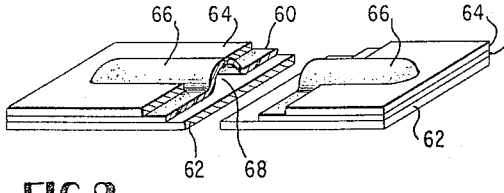


FIG. 8

FIG. 10

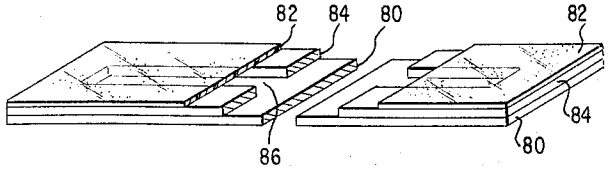
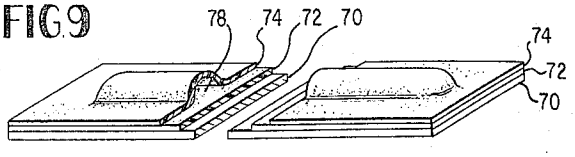


FIG. 9



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POSITION CONTROL APPARATUS WITH FLEXIBLE LEVEL INDICATOR AND MOUNTING STRAP

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Filed Feb. 24, 1964, Ser. No. 346,744
19 Claims. (Cl. 273—54)

This invention relates generally to arm position control apparatus and more particularly pertains to apparatus which provides a reference calibration of wrist rotation for sports and other selected activities.

Many sports activities depend upon precise wrist rotation as an initial condition for consistency in performance. Examples of sports activities in which consistent initial wrist angle is required for expert performance are: bowling, billiards, golf, baseball batting, archery, curling, shuffleboard, and horseshoe pitching, etc.

It has been discovered that people cannot easily sense a change in wrist angle of as much as plus or minus ten to fifteen degrees in a sequence of activities separated in time. This normal lack of angle sensibility is further degraded in many activities due to the presence of a heavy and/or clumsy object such as a ball, cue, golf club, etc. in the user's hand. For example, the angle at which a bowler's wrist is held before the start of his swing determines, to a measurable degree, the direction and magnitude of the curve which the ball traces in its trajectory along the bowling lane. Various tricks are employed by serious bowlers to attempt to attain a consistent initial wrist angle. Some tricks work reasonably well for many bowlers, but true precision is seldom attained.

The situation in which a bowling ball touches the floor just prior to being released is a complicated dynamics problem in which inertia, friction, misaligned force vectors, and gyroscopic principles are involved. The curve of a tenpin bowling ball, having one or more holes selectively spaced on its surface, as it is rolled along its trajectory, is created by the action of the fingers which remain in the ball momentarily after the thumb is withdrawn. The force vector of the fingers is laterally displaced from the inertia vector passing through the centroid of the ball. The amount of this misalignment is seen to be governed by the rotational angle of the wrist just prior to release. The degenerate case in which the force and inertia vectors are aligned occurs only when the inner wrist is forward in the direction of motion at release. In this case, the fingers are in line with the inertia vector. Consequently, a straight roll results. The more usual situation is complicated by rotation of the ball imparted during the swing. In general, the ball contacts the lane with a certain forward velocity and an angular momentum about some axis. An additional rotation about a second axis is created in the roll of the ball along the lane towards the pins. In essence, a combination of gyroscopic precession about the rotational axis, and a cross lane roll imparted by the ball's spin, combine to force the trajectory of the ball into a long arc curve. If this curve can be consistently delivered by the bowler, his choice of apparent aiming points can yield controllable target points. Such consistency produces significant increases in scoring. A similar analysis applies to bowling with a non-holed ball such as used in bowling duckpins, except that the frictional contact with the fingers is substituted for the finger location in holes.

The kinematics problem just described is combined with the problem of human physical coordination. For consistency, most people require a methodical approach in which they practice with a certain, non-varying, initial position, stance, pace, swing, release, and follow through. Each element is dependent on all others. Continual practice provides integration of the many physiological and physical elements into a single smooth motion or delivery.

It is an object of the present invention, therefore, to provide a lightweight, flexible angular position indicator which can be attached to the user's body and which will conform to the curve of the limb to which it is attached.

It is another object of the present invention to provide means for sportsmen and the like to achieve a consistent initial position with relation to the angle of wrist rotation.

It is still a further object of the present invention to provide a means for bowlers and the like to achieve a consistent initial position of wrist rotation in holding a bowling ball during the initial stance prior to delivery of the ball down the bowling lane.

Briefly, the subject invention comprises a transparent tube, preferably of a flexible material, mounted upon a calibrated base plate which is also preferably made of an easily deformable material. The transparent tube contains a fluid and a bubble of gas or a fluid which is adapted to move within the tube and along the calibrated plate when movement occurs. The combination of the transparent tube and the calibrated plate are fixedly attached to a flexible strap for attachment to the user's body. The invention is secured to the user's body, for example the wrist, and the combination of the transparent tube and the calibrated plate is bent to conform to the user's wrist such that a large dynamic angular measurement of wrist rotation is provided by movement of the bubble which measurement allows the wearer to angularly position his wrist repeatedly in a predetermined position.

Other objects and advantages will become apparent as a reading of the following detailed description proceeds when studied in light of the following drawings in which:

FIGURE 1 is an illustration helpful in understanding the present invention;

FIGURE 2 is a drawing illustrative of the preferred embodiment of the subject invention;

FIGURE 3 is a drawing helpful in understanding the preferred embodiment shown in FIGURE 2;

FIGURE 4 is a drawing illustrative of one type of flexible tube which can be utilized in the subject invention;

FIGURE 5 is a drawing of yet another type of flexible tube;

FIGURE 6 is a drawing illustrative of one embodiment of the subject invention in which the level tube and the calibrated plate are integrated into a single unit;

FIGURE 7 is another embodiment of the subject invention comprising an integrated unit;

FIGURE 8 is still another embodiment of the subject invention employing an integrated unit;

FIGURE 9 is yet another embodiment of the subject invention in which the level and base plate are integrated into a single unit; and

FIGURE 10 is a drawing of still another embodiment of the subject invention in which the level and base plate are integrated into a single unit.

Considering the drawings in detail, FIGURE 1 illustrates the manner in which the subject invention achieves its desired objects. Shown therein is a view of the human elbow, forearm, wrist, and hand including the fingers. The thumb, forefinger, and middle finger of the hand are extended outwardly at mutually right angles to one another. An orthogonal coordinate system is superimposed such that the thumb defines the Z axis, the forefinger defines the Y axis and the middle finger defines the X axis. Apparatus comprising the subject invention is shown attached to the wrist of the wearer with the level portion appearing on the upper curved portion thereof. It will become apparent with an examination of FIGURE 1 that two axes of rotation, those about the X and Z axes,

are available at the wrist; however, rotation about the Y axis (represented by the pointing forefinger) cannot be performed at the wrist joint. Rotation about the forefinger can only be achieved using the elbow. Consequently, any rotation about the forefinger implies precisely equal rotation of the wrist through the elbow joint. Therefore, initial wrist angle, defined as the rotational angle of the wrist about the Y axis, can be precisely controlled by reference to the calibration markings included on the subject invention.

With respect to FIGURE 2, the preferred embodiment of the subject invention is shown comprising a flexible transparent tube **10** containing a fluid **12** and a bubble **14** of a gas or other suitable fluid. The tube **10** is mounted upon a selectively deformable plate **16** having indicia **17** in the form of graduations printed thereon to form a calibrated plate. The tube **10** and the calibrated plate **16** are attached to a flexible strap **18** which includes a buckle **19** for temporary, relatively immovable, attachment to the user's body. A preferred means of mounting the flexible tube **10** and the calibrated plate **16** to the flexible strap **18** is shown in FIGURE 2 where one or more staples **20** are driven through the plate **16** and the strap **18** and clinched on the underside thereof so that each tab end **30** of the tube **10** is secured under the loop of the staple **20**. The staple **20** and the ends of the flexible tube **10** are concealed by the tabs **22** formed by shaping and bending the ends of the calibrated plate **16**. A strip of compressible non-skid foam material **24** is attached to the underside of the flexible strap **18** opposite the position of the calibrated plate **16** and the flexible tube **10**. For use, the entire assembly is bent to conform to the portion of the user's body to which the subject invention is attached, for example, the wrist. The flexible strap **18** is buckled to the user's wrist with the tube **10** and the deformable calibrated plate **16** located in such a manner that when the user, for example, holds his bowling ball in his usual pre-swing manner, the bubble **14** is substantially centered in the graduations appearing on the calibrated plate. The user practices a few times to determine the correct bubble position for his particular style of delivery; and thereafter always returns his wrist to the same rotational position before the start of every swing using the calibration marks on the calibrated plate **16** for reference.

The flexibility of the calibrated plate **16** is chosen to be preferably a compromise between the softness required to allow easy bending for initial fitting to the curve of the user's wrist and the stiffness required to retain its shape in the same curve between periods of use when being worn. The foam material **24** allows the wrist expansion and contraction attendant upon sporting activities and prevents slippage of the assembly around the user's wrist as well as providing a certain degree of comfort.

Referring now to FIGURE 3 which is a diagram helpful in the understanding of the preferred embodiment shown in FIGURE 2, the flexible tube **10** is formed such that the tab ends **30** of the tube are coplanar with one side thereof. This configuration reduces the stress in the tube when the assembly is formed in an arc as shown by the dashed lines. Excessive stress tends to flatten the tube **10** and, if a gas bubble **14** is utilized, tends to cause absorption of the gas into the fluid.

FIGURE 4 is illustrative of another embodiment of the tube **10** in which the calibrated plate of the embodiment shown in FIGURE 2 has been replaced by an internal calibrated plate **32** having graduations printed thereon which is sealed into the flexible tube **10** at the time of fabrication.

FIGURE 5 is yet another embodiment of the flexible tube **10** where the indicia **34** comprising the calibration markings are provided on the internal or external surface of the tube **10** itself, thereby eliminating the need for the aforementioned calibrated plate **16**. The bubble **14** is then made to be centered between the graduations **34**.

FIGURE 6 illustrates one embodiment of the subject invention in which the calibrated plate and flexible tube are fabricated into a single unit. A transparent plastic sheet **40** is bonded to a deformable plate **46** in such a fashion that an unbonded protuberance **42** exists longitudinally along the center. The semi-cylindrical cavity **44** so formed in the unbonded section is partially filled with a suitable fluid. Calibration markings, not shown, can be located on either side of the plastic sheet **40**, or when desired upon the upper surface of the plate **46**.

FIGURE 7 illustrates another embodiment of an integrated plate and tube. An easily deformable preferably metal plate **50** is stamped with a semi-cylindrical impression **54**. A plain transparent plastic plate **52** is bonded to the plane surface of the plate **50**. The semi-cylindrical cavity **56** formed in the stamped depression **54** is partially filled with fluid. Calibration markings, not shown, can be located on either side of the transparent plastic plate **52** or when desired upon the upper surface of the plate **50**.

Yet another embodiment of the integrated plate and tube is shown in FIGURE 8. Shown therein is a transparent sheet of plastic material sandwiched between an easily deformable preferably metal base plate **62** and aperture plate **64**, also easily deformable. Bonding of the three pieces **60**, **62** and **64** is performed in a well known manner such that a protuberance **66** is formed in the plastic sheet **60** so that the sheet **60** bulges outward through the aperture plate **64**. The semi-cylindrical cavity **68** so formed is partially filled with a suitable fluid. Indicia comprising calibration markings, not shown, can be located when desired on the aperture plate **64** on either side of the protuberance **66** and on the revealed portion of the base plate **62**.

Still another embodiment of the integrated plate and tube structure is shown in FIGURE 9. A semi-cylindrical cavity **78** is formed between two plastic sheets **72** and **74** in a manner similar to that described with regard to FIGURE 6. This assembly is then bonded to an easily deformable base plate **70**. Calibration markings can be selectively located on any revealed surface.

Still another embodiment of the integrated plate and tube structure is shown in FIGURE 10. An easily deformable metal plate **80** and a transparent flexible plastic plate **82** are bonded to either side of a metal aperture plate **84**. The cavity **86** formed by the aperture plate **84** and the two plain plates **80** and **82** is partially filled with fluid. As with the other embodiments previously described, the calibration markings not shown can be selectively located on any revealed surface.

While there have been shown and described what are at present considered to be the preferred embodiments of the invention, modifications thereto will readily occur to those skilled in the art. It is not desired, therefore, that the invention be limited to the specific arrangements shown and described, but it is to be understood that all equivalents, alterations, and modifications within the spirit and scope of the present invention are herein meant to be included.

I claim as my invention:

1. A position control apparatus adapted to be worn on the limb of a user comprising a flexible strap, and a flexible bubble indicator means connected to said strap, whereby the combination of said flexible strap and said flexible bubble indicator means are conformable to the contour of the limb of the user.

2. A position control apparatus adapted to be worn on the limb of a user comprising a flexible strap adapted to be securely fastened to said limb, and a flexible position indicating device containing a fluid connected to said flexible strap, whereby the combination of said flexible strap and said indicating device are conformable to the contour of the limb of the user.

3. Apparatus for noting the amount of angular rotation of the wrist of a user comprising, flexible bubble indicat-

ing means, a flexible strap adapted to be securely fastened to said wrist and means connecting said flexible bubble indicating means to said flexible strap, whereby the combination of said flexible strap and said flexible bubble indicating means are conformable to the contour of the wrist of the user.

4. Arm position control apparatus comprising, a flexible bubble indicator, a flexible strap adapted to be securely fastened to a selected limb of a wearer and means for connecting said flexible bubble indicator to said flexible strap, whereby the combination of said strap and said indicator are conformable to said limb of said wearer.

5. The invention as recited in claim 4 wherein said bubble indicator comprises, a deformable plate, a flexible transparent tube containing a fluid and means for mounting said transparent tube on said plate.

6. The invention as recited in claim 4 wherein said bubble indicator comprises, a deformable base plate having indicia imprinted on one surface thereof in the form of graduations, a flexible transparent tube closed at both ends and containing a fluid and a bubble therein, and means for attaching said transparent tube to the surface of said base plate containing said indicia.

7. The invention as recited in claim 4, and including a strip of compressible material attached to the surface of said flexible strap opposite from the surface to which said flexible bubble indicator is connected.

8. The invention as recited in claim 4, and including a strip of compressible non-skid material attached to the undersurface of said flexible strap opposite said flexible bubble indicator.

9. The invention as recited in claim 4 wherein said bubble indicator comprises a tube of flexible transparent tube having tab ends pressed together such that said tab ends are coplanar with one side of said tube, a deformable base plate member having indicia in the form of graduations imprinted on one surface thereof and means for mounting said flexible tube to said one surface at said tab ends of said flexible transparent tube.

10. The invention as recited in claim 4 wherein said bubble indicator comprises a flexible transparent tube closed at the ends and containing a fluid and a bubble, said bubble being adaptable to move within said tube upon movement thereof, and indicia means imprinted on one surface of said tube in the form of graduations for calibrating the movement of said bubble.

11. The invention as recited in claim 4 wherein said flexible bubble indicator comprises a flexible transparent tube closed at the ends and containing a predetermined quantity of a fluid therein and a flexible calibrated plate mounted inside of said tube so that said calibrated plate is visible through said tube.

12. The invention as recited in claim 4 wherein said bubble indicator comprises a deformable base plate member and a transparent sheet of plastic material bonded to said base plate member in a manner such that an unbonded protuberance is formed a predetermined length longitudinally substantially along the center of said base plate member.

13. The invention as recited in claim 12 and including indicia in the form of graduations imprinted thereon.

14. The invention as recited in claim 4 wherein said bubble indicator comprises a selectively deformable base plate member having a substantially semi-cylindrical impression of a predetermined length running along one dimension and being substantially centered along the face thereof, a plain transparent plastic plate bonded to said face, a predetermined quantity of fluid partially filling said impression, and indicia in the form of calibration markings selectively imprinted upon a selected surface.

15. A position control apparatus adapted to be worn on the arm of a user comprising in combination, a flexible position indicating device including a deformable base plate member, a deformable aperture plate member and a transparent sheet of plastic material bonded between said base plate member and said aperture plate member forming a protuberance in said plastic sheet outwardly through said aperture plate member, said protuberance additionally having a predetermined quantity of fluid therein forming a bubble which is adapted to move within said protuberance as said apparatus is moved; a flexible strap; and means for connecting said flexible position indicating device to said flexible strap, whereby the combination of said flexible strap and said indicating device is conformable to the contour of the arm of the user.

16. The invention as recited in claim 15 and including indicia in the form of graduations selectively located on a predetermined revealed surface.

17. A position control apparatus adapted to be worn on the limb of a user comprising in combination, a flexible position indicating device including a deformable base plate member, a first sheet of plastic material and a second sheet of plastic material, said first and said second sheets being bonded together in a manner that a semi-cylindrical cavity is formed therebetween for a predetermined length, and means for bonding said first and said second plastic sheets to said base plate member; indicia means in the form of calibration markings selectively located on a surface of said indicating device; a flexible strap adapted to be securely fastened to the arm of said user and means connecting said flexible position indicating device to said flexible strap whereby the combination is conformable to the contour of the arm of the user.

18. An arm position control apparatus adapted to be worn on the wrist of a user comprising in combination, a flexible bubble indicator means comprising a plate of deformable material and containing an aperture a preselected distance along its length, another deformable plate bonded to one side of said aperture plate and a plate of transparent plastic material bonded to the other side of said aperture plate, a fluid partially filling said aperture effecting a bubble therein which is adapted to move within said aperture as the rotational position of the wrist is varied; indicia comprising calibration markings located on a selected revealed surface of said bubble indicator means; a flexible strap adapted to be securely fastened to the wrist; and means connecting said bubble indicator means to said flexible strap whereby the combination is conformable to the contour of the wrist of the user.

19. An arm position control appartus adapted to be worn on the wrist comprising, flexible bubble indicator means; a flexible strap having a buckle attached to one end thereof, permitting said apparatus to be securely fastened to the wrist; means connecting said flexible bubble indicator means to said flexible strap on one side; and a strip of compressible non-skid foam material connected to the other side of said flexible material opposite said bubble indicator means, whereby the combination of said flexible strap, said indicator means and said strip of foam material is readily conformable to the contour of the wrist.

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