A disc that dynamically changes as it flies

DESCRIPTION

[Para 1] Background Of The Invention

[Para 2] 1. Field of the invention

[Para 3] The present invention relates to the art of flying discs for use in various disc sports, and more particularly, to the design of flying discs having features for controlling flight characteristics.

[Para 4] 2. Description of the Related Art

[Para 5] Flying discs are used in many recreational and sporting activities. Popular flying disc sports include, but are not limited to: Ultimate; Double-Disc Court; MTA (Maximum Time Aloft) competitions, Distance throwing competitions; throw and catch games, and the sport of Disc Golf. Among the preferred discs used in each of these sports and recreational activities, there are wide ranges of desired characteristics, including, but not limited to:

- o · Strength of throw required, for example, requiring a strong throw from an experienced player, or a weaker throw from a beginner.
- o · Fight characteristics, for example, the tendency of the disc to "Fade" to the right or to the left as the disc slows down near the end of its flight, or the tendency to fly straight.
- o · Disc "Stability", which is the capacity to be released at high speeds and/or into a head wind, and resist "Flipping" (a rotation of the planar axis of the disc that occurs in response to rotational acceleration of the disc around the center axis). A disc designed with features that provide a high degree of stability (known as "over-stable" discs) can be released at high speeds without flipping, however, as the disc decelerates near the end of its flight, it will fade (rotating back upon the same planar axis it was resisting upon the release). Discs

designed with features that provide a low degree of stability don't fade as much near the end of their flight.

- o · Disc "Glide", the capability to maintain aloft for a long time, providing longer flight distance. Discs that are flat don't glide as well as those shaped like a dome. Over-stability also diminishes glide capability.
- o · Trick shot capabilities, for example, rolling the disc on the ground, or skipping it off the ground as it flies.
- o · The material the disc is made of, which in turn affects the weight, flight characteristics, as well as durability, grip ability, and flexibility.

[Para 6] Players of most disc sports utilize only one disc, however, in the sport of disc golf, players typically carry several, perhaps dozens of discs, each of which is used for its particular set of flight characteristics, in order to address the wide variety of throws required to play. Similar to the various clubs used in the sport of conventional ball golf, disc golf players use different "Drivers", "Mid-Ranges" and "Putters" for long, medium, and short shots, respectively.

[Para 7] Disc golf drivers typically require higher degrees of throw strength, and have more stability, but provide less glide during flight, and exhibit more fade at the end of the flight. Shorter-range discs typically exhibit the opposite characteristics. The flight characteristics of drivers result from designing discs with wider contours in the outer rim, and have more flatness in the center plate. Also, the distribution of weight in drivers is typically heavier toward the outer rim, known as con-centric weight distribution, as opposed to center-centric weight distribution typically found in shorter-range discs.

[Para 8] The manufacturers of disc golf discs strive to create discs that address every kind of shot that may be encountered in play. Top disc manufacturers each provide hundreds of different combinations of models and weights, and are constantly creating new designs and materials. However, current disc manufacturing technology uses fixed shapes and fixed weight distributions, and thus suffers from having to settle with designs that compromise overall performance for the sake of tradeoffs between desired flight characteristics.

[Para 9] Jim Kenner, the owner of DisCraft, Inc., the world leader in disc sports, has stated “There is always a trade-off between stability and glide. You either have one or the other. The trick is to design a disc that can be released at very high speeds and yet still glide a long way.”

[Para 10] United States Patent 5531624 (Dunipace) describes, in great detail, the need for disc designs that provide optimal overall performance. However, because of the tradeoffs imposed by the conventional technology used, Dunipace admits “The present inventor has recognized there is still room for additional improvement in the design of flying discs.”

[Para 11] Accordingly, it is desirable to develop a mechanism by which flying discs can be made to dynamically change while in flight, and thus provide a whole new range of capabilities. By utilizing the DFWeightShift and DFDynaForm effects (described below), flying discs can, at last, be designed to perform in a great variety of flight patterns, which are unachievable without these capabilities. For example, features characteristic of high-speed discs can be implemented during the high-speed portion of the flight, and then transition into features characteristic of low speed discs during the low-speed portion of flight. The designers of discs can thus pick and choose certain flight characteristics to appear or disappear during various phases of flight. This means no more compromising, and no more setting for trade-offs, when designing new high performance discs, or when retro-fitting these new effects onto existing designs.

[Para 12] [Para 2] Specifications

[Para 13] The device is a flying disc, thrown in the normal fashion consistent with flying discs. The flying disc can be thrown for fun and enjoyment, or used in various disc sports including Disc Golf and Distance competitions.

[Para 14] The center plate of disc encasement contains a fluid filled diaphragm made of an elastic material. The outer rim cavity also contains a fluid diaphragm made of elastic material. A series of holes and connecting tubes connect the inner and outer diaphragms, such that they act as a set of reservoirs, allowing the fluid to flow between them.

[Para 15] When the disc is thrown, it is naturally spun around the center axis, generating centrifugal forces that propel some of the fluid from the inner reservoir toward the outer radius of the disc, through the connecting tubes, into the outer reservoir. The amount of centrifugal force generated is proportional to the rate of the spin, thus, the faster the spin; the more fluid is shifted from the inner to the outer reservoirs. As the disc's spin slows down near the end of its flight, the elastic property of the diaphragms returns the displaced fluid back into the center reservoir. These shifts in fluid between the center of the disc and the outer rim in response to the axial rotational speed are herein referred to as the DFSpinShift Effect.

[Para 16] The DFSpinShift Effect is the mechanism, upon which additional effects (described below) are implemented, which in turn create dynamic flight-altering effects upon the disc while in flight. The volume and flow rate of fluid moving between diagrams during DFSpinShift Effects are key factors in controlling the magnitude and the characteristics of these dynamic flight-altering effects. Varying the following specifications in various discs designed upon these principles can control this fluid flow:

- o · Fluid viscosity: If the fluid is thicker, it will slow the rate of flow between diaphragms, resulting in a slower transition of these effects. If the fluid is thinner, the opposite takes place.
- o · Fluid density: The denser the fluid the more pronounced the DFWeightShift Effect (described below).
- o · Length and diameter of the connecting tubes, number of connecting tubes: Longer tubes and/or tubes with smaller diameters, or less number of tubes also result in a slower flow rate.
- o · Elasticity of the diaphragms and/or connecting tubes: Lesser elasticity of these components will also result in decreased flow rate.
- o · The volume of fluid present within the diaphragms and tubes: Less fluid means less total flow.

[Para 17] As the disc spin-up occurs, and fluid is shifted from the inner plate to the outer rim, there is a shift in the disc's weight distribution, from the center of the disc to the outer rim, so the disc develops a more con-centric weight distribution. As the disc spins-down, the fluid shifts back to the center, and thus the disc develops a more center-centric weight distribution. This shift in weight distribution between the center of the disc and the outer rim is herein referred to as the DFWeightShift Effect. This effect is the means by which dynamic weight distribution changes are implemented during the disc's flight. For example, conventional discs designed for long distance throws typically use more con-centric weight distributions that maximize spin when released at high speed. On the contrary, discs designed for shorter distances typically use more center-centric weight distributions for shorter straighter flights. By incorporating the DFWeightShift effect, discs can be designed with con-centric weight distribution during the high-speed phase of the flight, and then transition to center-centric weight distribution as the disc spins down near the end of its flight. The result of this design is a disc that maximizes spin upon high-speed release, as high-speed discs are designed for, and then finish strait, as low-speed discs are designed for.

[Para 18] The DFWeightShift effect also changes the properties of rotational inertia displayed by the disc. As the fluid shifts back to the inner diaphragm in the later phases of the disc's flight, and the weight distribution becomes more center-centric due to the DFWeightShift effect, the free-flying disc will increase its rotational speed due to the same laws of physics that cause figure skaters performing a spin to speed up when they pull their arms in. The result is a disc flight that has an extra burst of rotational speed at the disc flight winds down. This increase in rotational speed as a result of the DFWeightShift effect in the later phases of the disc's flight is herein referred to as the DFFluidTorque Effect.

[Para 19] The shifting of fluid within the disc can also be used to alter the outer facets and contours of the disc, herein referred to as the DFDynaForm Effect. This effect is the means by which dynamic changes to the shape of the disc are implemented during various phases of its flight. For example, conventional discs designed for long distance throws use wide rim contours that resist "flipping" when released at high speed. On the contrary, discs designed for shorter distances use smaller rim contours that provide straighter flights and require less throwing force. By incorporating the DFDynaForm effect, discs can be designed that extend the rim contour during the high-speed phase of the flight, and then retract the rim contour as the disc winds down near the end of its flight. The result of this design is a disc that resists "flipping" upon high-speed release, and then finishes without fading.

[Para 20] In addition, DFDynaForm Effect designs can utilize an inner reservoir that exposes the elastic diaphragm to the top of the center plate, thus giving the center plate a dome shape at the end of the flight, but a flat plate upon release. The result of this design is a disc that resists “flipping” upon high-speed release, and then glides for a very long time.

[Para 21] Varying combinations of these effects provides a whole new range of disc designs, resulting in new discs with capabilities that cannot be achieved without these effects, thus dramatically out-performing conventional discs. Designs based upon the above specifications are herein referred to as DFFluidTorueDiscs.

[Para 22] The designs described above utilizing internal diaphragms and connecting tubes is hereby referred to as the “Complex Design”. These discs are very expensive to produce, compared to production of conventional discs. As an alternative to the complex design, sealed elastic tubes containing fluid can simply be attached to conventional discs, creating the same DFSpinShft effect, and thus creating DFWeightShift and DFFluidTorque effects at a fraction of the cost required for the complex design. These tubes are herein referred to as DFSpinTubes. These are attached to conventional flying discs in mounting slots herein referred to as DFSpinTubeSlots.

[Para 23] The claims below and the embodiment described above should not be constructed to limit the invention to the exact details of structure described therein. Those persons skilled in the art for which this invention applies will readily identify modifications that are not specifically described, but are intended to be covered.