The invention relates to yo-yos and in particular high-performance ball- or roller-bearing yo-yos capable of extremely wide string-gap settings suitable for "new school" yo-yo tricks. The present invention addresses the need to center the yo-yo string on the bearing or bearing sleeve along the axial extension of the outer surface of the yo-yo bearing or bearing sleeve or in relation to the effective "string gap" between the opposed inner faces of the two yo-yo halves. The present invention also provides an effective and economical string-bearing surface able to span the wider string gap required by "new school" styles and modes of play. The present invention enables the variable stacking of successive layers of string either side of the securing loop during complicated yo-yo string trick routines.
Figure 3
YO-YO BEARING MEMBER

CROSS-REFERENCE TO RELATED APPLICATION


FIELD OF THE INVENTION

[0002] The invention relates to yo-yos and in particular high-performance ball- or roller-bearing yo-yos capable of extremely wide string-gap settings suitable for “new school” yo-yo tricks. The rapid emergence of new skills amongst practitioners has prompted the invention of new types of yo-yos; the present invention resolves many of the difficulties involved in producing such yo-yos.

BACKGROUND OF THE INVENTION

[0003] The introduction of ball-bearing yo-yos in the nineties saw a quantum leap in the possibilities for new yo-yo tricks and techniques due to the enormously extended spin times afforded by ball- and roller-bearing yo-yos. These techniques, referred to as “new school”, involve the elaboration of many layers of string between the spinning yo-yo halves—many as five or six layers as the string is doubled and re-doubled in successive “mounts” in a trick sequence.

[0004] One of the limitations to this type of yo-yo play was the premature return of the yo-yo to the player’s hand due to snagging of the string on the “starburst” pattern of raised ridges on the medial faces of the yo-yo halves. Many players would file these ridges flat. This snagging could be occasioned either by too many layers of string between the halves, or by the end loop of a single-looped yo-yo string “wandering” across the cylindrical face of the bearing or bearing sleeve, enabling the string to contact the starburst, thus causing the yo-yo to return.

[0005] Conversely, another limitation to this type of play was the difficulty of setting a wide enough string gap to accommodate a plurality of layers of string, and yet having the response capability to snare and rewind the string so as to return the yo-yo to the player’s hand on demand. A further limitation was that, at extremely wide string gap settings, the axial extension of the cylindrical outer surface of the roller bearing was insufficient to maintain the string in a central position with respect to the medial faces of the yo-yo halves, to prevent bearing slap and to prevent the string becoming snagged between the bearing and the said medial faces.

[0006] Yo-yo manufacturers have devised means for centering yo-yo strings in relation to yo-yo bearing mechanisms. As marketed in 1997, the Black Mamba Five-Star™ yo-yo, subject of U.S. Pat. No. 5,984,759 (O’Sullivan), was provided with a steel ball-bearing having a circumferential groove in the external surface of its outer race. An alternative embodiment, the Black Mamba Three-Star™ was marketed worldwide at the same time and was provided with a concave acetyl bearing.

[0007] Amaral U.S. Pat. No. 4,895,547 discloses an attempt to center the yo-yo string in relation to a yo-yo bearing spool mounted on the yo-yo axle by means of a circumferential groove formed about the periphery of the spool at about its midsection. This was previously described in Caffrey U.S. Pat. No. 4,332,102 which has a similar annular groove formed in the outside of said bearing. This described groove is additionally coupled to a cylindrical surface adapted to be engaged by a clutch mechanism. As manufactured and sold, the Caffrey groove has a width of slightly more than one string diameter and has a U-shaped base region defining in part a segment of a circle having a diameter slightly greater than one string diameter and has a depth sufficient to accommodate two wraps of string.

[0008] Marcantonio U.S. Pat. No. 6,565,408 discloses a groove approximately three string diameters deep and a little more than one string diameter wide. The groove is wide enough and deep enough to accept a second wrap of string. This refers to a full lay of string, rather than a loop, in the “V-shaped lead-in portion” of the groove which has “a maximum distance at its widest . . . of no greater than the minimum distance between the facing starbursts on the two inner shells” and is described as “defining an angle of less than 45 degrees. This is similar to the geometry of a narrow string-gap yo-yo of the type described in U.S. Pat. No. 4,895,547 (Amaral).

[0009] U.S. Pat. No. 4,895,547 (Amaral) has demonstrated, in regard to effective yo-yo response or recall, the maximum reach of a set of integral raised starbursts of a polymer suitable for the construction of a robust yo-yo half is a maximum distance of 0.09 inches or 2.29 mm.

[0010] The Marcantonio U.S. Pat. No. 6,565,408 disclosure appears to provide a vertical stacking of the string in a narrow string guiding groove which may create an imbalance between the ratio of yo-yo outside diameter and the speed generating and string rewinding bearing sleeve outside diameter. This is the result of having to provide support structure, and the only engineering way, due to limitations imposed by the known effective string snaring capacity of an integral starburst response system, is to provide structure by increasing the bearing outside diameter that is at right angles to the axle. A high performance yo-yo cannot generate sufficient throw thrust if the start of the rewind string starts two thirds out from the start of the radius of the yo-yo half and finishes one third from the center of axis of spin.

[0011] The correct ratio of bearing outside diameter to yo-yo half outside diameter is around a maximum of 20%, and smaller being preferred, for optimum spin performance. An outside diameter of 30% plus effectively makes the task of producing a high performance yo-yo impossible. The diameter of the bearing surface acts as the axis of spin and the smallest diameter grants the highest latent spin energy. The art of building high performance yo-yos requires attention to these fundamental performance ratios. The depth dimension of such a bearing sleeve is five to six times the width dimension.

[0012] O’Sullivan U.S. Pat. No. 5,984,759 of the inventor herein discloses a means whereby a yo-yo is enabled to automatically return to the player’s hand at a predetermined speed. In one embodiment that invention overcomes the above mentioned yo-yo string centering problem by enabling the clutch mechanism to directly snare the yo-yo string by acting symmetrically about the mid-point between the yo-yo halves. Another embodiment enables the clutch mechanism, by movement substantially parallel to the axis of rotation of the yo-yo, to contact the effective lateral face(s) of the bearing sleeve. The secure attachment of the bearing sleeve is achieved by pressurized insertion of the
ball bearing. During insertion the engineering plastic has sufficient expansion and polymer memory to accommodate insertion and yet retain a securely fixed mode in relation to the enclosed relatively inflexible steel ball bearing. This is important to minimize undesirable sound and adverse vibration characteristics.

SUMMARY OF THE INVENTION

[0013] Briefly stated, the invention in a preferred form is a bearing member for a yo-yo. The bearing member comprises a spool symmetric about an axis of rotation. The spool has an inner cylindrical surface of axial length L and an outer string bearing surface defined between a pair of axially spaced ends, each having an axially extreme circular edge which has a radius greater than the distance from the axis to the string bearing surface. The axial distance D between the extreme edges is greater than the length L. In addition, the axial distance D is greater than the radial distance between the inner cylindrical surface and the outer string bearing surface. The string bearing surface forms a concave recess between the ends which defines a profile of a surface of revolution about said axis and has a variable depth. The depth of the profile relative to the extreme edges is greatest at the axial midpoint and is generally symmetric relative to the midpoint.

[0014] The bearing member in one application is employed in conjunction with a set of yo-yo halves with thermoplastic elastomer discs presenting string snaring surfaces of superior effect by utilizing surface or cling adhesion to snare the yo-yo string. The response surface, in relation to the effective inner plane of the yo-yo halves, may be flush, recessed with or without starburst, or with a partially raised portion and a bearing sleeve with the concave surface to accommodate advanced string trick play.

[0015] The concave surface also centers the string utilizing the centrifugal and gravitation forces pulling against its gentle yet sufficient gradient till the string settles at the lowest point. The string is not restrained and is allowed to move freely up and along this gradient as the play routine dictates.

[0016] To accommodate the required width in contrast to related prior art yo-yos where the bearing extension must be in the direction at right angles to the axle, the bearing extends in a coaxial direction with the width being considerably greater than the rather shallow depth requirements.

[0017] The geometry of the yo-yo half exhibits an aperture rather than a recess to accommodate the laterally extended bearing sleeve.

[0018] The present invention addresses the need to center the yo-yo string on the bearing or bearing sleeve along the axial extension of the outer surface of the yo-yo bearing or bearing sleeve or in relation to the effective “string gap” between the opposed inner faces of the two yo-yo halves. The effective string gap is defined as the axial distance between the opposing medial faces of the two yo-yo halves or between any projections therefrom, or between other fixed or moveable intrusions into the space which may effect the yo-yo string during normal play.

[0019] The present invention utilizes a standard steel ball bearing and encloses the outside diameter of the bearing to provide a polymer/metal sleeve with sufficient width to allow an effective concave gradient to be presented to the securing yo-yo string so that the string is free to glide across the surface and take the position of least resistance in conjunction with subsequent lays of string during advanced string trick performance.

[0020] An effective gradient suited to the coefficient of friction of an engineering polymer is around 13 degrees. A metal sleeve may be marginally less than 13 degrees.

[0021] The width of the concave shape ideally presents around 5 mm-6 mm with a concave depth of only 0.375—a third of the diameter of a string.

[0022] The present invention utilizes a means of superior string snare technology that is surface cling in operation rather than by the phenomena of a geometric obstruction that is the fundamental operating quality of the raised starburst. Response means such as an insertable thermoplastic elastomer disc or stick on high surface coefficient of friction material breaks the restriction on string gap width imposed by the limiting effect of a yo-yo half integral starburst string snaring capacity.

[0023] The present invention also provides an effective and economical string-bearing surface able to span the wider string gap required by “new school” styles and modes of play.

[0024] The bearing or bearing sleeve of the present invention may be further shaped by the gradual slope or gradient of the concave surface to assist the stringing up of the yo-yo as well as to guide or hold the string in a centralized position. The outer circumferential surface of the bearing or bearing sleeve may be provided with a concave surface to assist in maintaining string clearance from the yo-yo and/or string snagging means utilized on the yo-yo inner faces, such means being provided to assist in yo-yo recall. This string-centering and clearance-maintaining function applies not only to the initial loop of the yo-yo string but also to subsequent lays of string between the yo-yo halves, that is, subsequent lays of string are also urged towards the center of the string gap or in an orderly lay.

[0025] In a further embodiment, the bearing sleeve may be enabled to interact with an automatically returning yo-yo clutch mechanism as described in U.S. Pat. No. 5,984,759 (O’Sullivan) by providing a frictional surface on at least a part of its outer circumference or on its lateral face.

[0026] The bearing sleeve may be constructed of one or more parts shaped to fit around and fixedly hold a ball- or roller-bearing or other friction-reducing means between its inner surface and the yo-yo axle. The bearing sleeve could also be fitted with a frictional surface substantially on one or more of its lateral faces or or at least part of its outer circumference.

[0027] Owing to the recent explosion of yo-yo performance styles, a greater diversity of skill levels has emerged in the playing public. To accommodate this diversity and accompany the development of the individual player’s skills, a variety of string-gap settings on the same model or on different models of yo-yo is required. Beginners require narrower string gaps with sensitive recall response, while advanced players require wide string gaps and almost zero response.
Yo-yo manufacturers have previously responded by utilizing wider ball-bearing/bearing seat configurations. These are expensive and may increase the weight of the yo-yo near the axis of rotation, a factor considered negative in the refined high tech environment of rim weighted ultra long spinning yo-yos.

The present invention provides an economical and light weight solution to the problem of a string-bearing means in a yo-yo having an increased string gap without the significant expense, weight and rolling resistance of larger ball bearings and associated bearing seat and axle configurations.

The present invention further provides a novel friction reducing means by limiting the surface area of contact between the internal face of the bearing or bearing spool and the axle, whilst maintaining or increasing the effective axial length of the string bearing surface of the said bearing or bearing spool. The present invention provides a bearing or bearing sleeve wherein the axial extension of the external substantially cylindrical outer surface of the bearing or bearing sleeve is significantly greater than the axial extension of the internal cylindrical surface of the bearing sleeve in contact with the axle.

Silicon rubber disks, known in the yo-yo trade as friction disks, in the prior art utilize an adhesive backing and are applied to the yo-yo half medial face in proximity to the yo-yo string at the outer circumference of the yo-yo bearing. The silicon rubber has a surface coefficient of friction far greater than the material from which yo-yos are made. This allows the gap between the effective lateral faces of the yo-yo halfs to be set functionally wider, and the string still to be effectively snared by only a small jolt by the yo-yo operator.

An expert practitioner may chose a very wide string gap setting to perform complicated yo-yo string tricks and still be able to recall the yo-yo at will. In an embodiment of the present invention these high coefficient of friction snaring members are so positioned as not to intrude into the yo-yo string gap.

Yo-yo response means other than silicon rubber disks may be utilized.

The present invention provides a bearing or bearing sleeve which may fulfill the function of increasing the outside diameter of the string bearing means to promote optimum string response or recall. This superior recall is believed to be a function of the increased frictional contact between the yo-yo string due to the greater girth of a larger circumference bearing.

State of the art yo-yos may include effective string gap varying means. The present invention may be advantageously utilized in yo-yos where the effective string gap is able to be varied.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an isometric view of a bearing sleeve or ball-bearing outer race of an embodiment of the invention showing a partial view of the inner surface of same.

FIG. 2 is a perspective elevation of the same embodiment showing provision for an automatic return friction means.

FIG. 3 is a perspective view of another bearing sleeve in accordance with the present invention.

FIG. 4 is an enlarged central sectional view of the bearing sleeve of FIG. 3.

FIG. 5 is a central sectional view, partly in diagrammatic form, of a yo-yo incorporating the bearing sleeve of FIG. 4 in accordance with the present invention.

FIG. 6 is an enlarged fragmentary view, partly in diagrammatic form, of a central portion of the yo-yo of FIG. 6.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

With reference to the drawings, wherein like numerals represent like parts, FIG. 1 shows an isometric view of a bearing sleeve 10 or ball-bearing outer race of an embodiment of the present invention wherein the outer quasi-cylindrical face 20 is provided with a broad concave shaped outer surface 30 able to accept more than one lay of string. The distance C is the axial width of a contained bearing 40 in the case of a bearing sleeve, or of the inner race and the ball-race with dust-covers in the case of being a ball-bearing outer race.

FIG. 2 shows another view of the same embodiment, rotated horizontally through some 45 or so degrees from the previous figure, which shows the extension 50 of the outer surface 20 to accommodate a friction braking member (not shown) to be seated in groove 52.

Another embodiment of a bearing sleeve 10 is illustrated in FIGS. 3, 4, 5 and 6, a yo-yo 100 which employs the bearing sleeve 10 includes yo-yo halfs 102 and 104 connected by a threaded axle 110 which mounts a bearing 40 disposed between the halfs.

The bearing sleeve 10 is preferably in the form of a spool. Outer surface 30 is generally symmetric about an axial midpoint M. The spool is symmetric about an axis of rotation A which is the central axis of the yo-yo. The axial distance of the concave surface D is defined between axially extreme circular edges 32 and 34 which have a radius greater than the distance from the axis to the string bearing surface. The inner cylindrical surface of the spool has an axial length C. The axial distance D is preferably greater than the length C. The distance D is also greater than the radial spacing or thickness T between the outer concave string bearing surface and the inner surface. The yo-yo halfs further respectively include recesses 106 and 108 adjacent their inner central portions for receiving the axially extreme portions of the spool. The axial distance D preferably exceeds the axial width C by at least 10% of the roller bearing width C.

One embodiment of the present invention is a bearing sleeve 10 or bearing outer race that facilitates an effective string gap (greater than that previously provided) of around 0.18" or 4.5 mm to achieve complicated binds and double binds wherein the wider effective string gap must be wide enough to fit multiple lays of string; in the case of a double bind manoeuvre, of a double string lay crossed twice by a single string. The axial width C of the inner race of the bearing 40 or the contained bearing in the case of a bearing sleeve is maintained at a minimum width.
[0048] In another embodiment of the present invention, where considerations of stability demand it, more than one ball-bearing may be used in a bearing sleeve.

[0049] In an embodiment of the present invention where the primary string attachment to the yo-yo is restrained at the midpoint of the bearing sleeve 10 it is believed that it is possible to create yo-yo play possibilities for a more orderly and effective lay of strings by profiling the cylindrical outer face of the bearing or bearing sleeve.

[0050] Further effectiveness is achieved by shaping the bearing sleeve 10 or outer race in a manner that encourages the most efficient lay of string in the confines of a space created by an effective string gap of 4.0 to 4.5 mm (0.16" to 0.18") optionally in conjunction with or by means of a bearing surface that encourages the lay of strings away from the string snagging means 120. This is achieved by the concave surface 30 having the gradual slope or gradient m which urges the string toward the midpoint m. The preferred gradient m is approximately 13°. The yo-yo can still be recalled by a flick of the player’s wrist at this expanded effective string gap and effective greater string lay space created by the present invention.

[0051] It is foreseeable that the effective string gap width of the present invention can be further extended by improved yo-yo string snagging means 120. It is also possible to increase the effective string gap by reducing the caliper of the yo-yo string (not illustrated).

[0052] Many factors combine to set a range of minimum and maximum effective bearing and bearing sleeve inside and outside diameters. The size of the player’s hand determining the overall yo-yo diameter Y and the yo-yo axle determining the diameter of the ball bearing inner race inside diameter B are two primary design limitations for high performance spinning yo-yos. The size of players’ hands in the United States where modern yo-yo design evolved has dictated the external diameter Y of the yo-yo to between 54 mm and 62 mm.

[0053] String rewind inefficiencies start to progressively become evident above the typical United States ½" bearing external diameter (O.D.) or 12.7 mm. By using a bearing sleeve or by thickening the outer race of the ball-bearing of the present invention, the external diameter of the effective bearing surface may be extended to this approximate diameter yet utilize a small enclosed ball bearing, or ball race with a small diameter inner race, to promote a high speed long spinning yo-yo. Typically, in ball-bearings of this scale, the radial thickness of the inner race is 25-33% of the radial thickness of the annulus of the ball-bearing assembly, the outer race the same, and the ball race itself between 33% and 50%.

[0054] The present invention envisages increasing the thickness of the effective outer race beyond 33% to up to 60-70% of the annular thickness of the bearing assembly. This enables various string-restraining modalities of shape such as the outer surface described above to be incorporated within the thickness of the outer race. The effective outer race of the bearing comprises the major radial interval of the radius S of the bearing/bearing sleeve assembly and may comprise upwards of fifty per cent of the radial thickness S of the annular bearing assembly. The effective outer race R of the bearing in the present context is taken to mean either a unitary piece of suitable machined or moulded material, suitably dimensioned so as to constitute a functional ball-bearing assembly in combination with an inner race and a ball-race in accordance with the present invention, or a bearing sleeve, suitably shaped and dimensioned, mounted on a suitably dimensioned prior art ball-bearing. Of course, a unitary bearing spool of suitable shape and dimensions, made of a suitable material such as acetyl, Teflon® or nylon materials and having the axial extension of its outer face greater than the axial extension of its inner face adjacent to the axle may be provided to achieve a similar thickening effect, also within the scope of the present invention.

[0055] The above mentioned multi-layer string tricks require the wider string gap setting as well as high speed capacity to complete sequences of the above mentioned trick routines. The present invention may be shaped to allow these ideal settings of internal and external diameters of the effective bearing housing to optimize play performance and deliver comfort to the player. It is further understood that the efficient combination of the ratio of sizes of the aforementioned variables allows the design of a lighter yo-yo that further reduces the strain experienced by top performers who must play and perform for hours.

[0056] The term string is used throughout this present patent specification to effectively include other cord like materials and other cord end shapes, knots, ties or attachments that facilitate attachment or other superior string performance functions. The yo-yo “string” may be an extruded or moulded material.

[0057] The present invention, by incorporating a bearing sleeve 10 or 10' of light-weight material, allows the economical construction of a wider setting yo-yo with small internal diameter ball- or roller-bearings and small internal diameter surface friction thereby maximizing spin time and at the same time allowing a larger external diameter string bearing surface to optimize yo-yo recall. The above-mentioned efficiency ratios then allow for the reduction of yo-yo weight near the axis of rotation while still achieving the required complex string trick routines.

[0058] By contrast, prior art (U.S. Pat. No. 6,565,408 Marcantonio) has disclosed a bearing sleeve where the width is limited to the width of the enclosed bearing and has restraining flats. The corresponding width is further limited by the perceived need to utilize star burst configurations (radial ribs) on the yo-yo inner faces. Prior art U.S. Pat. No. 4,895,547 (Amalar) has effectively shown that the ideal width between the two star burst patterns of the medial faces of the yo-yo halves to be about 0.073" to 0.090". In practical design the bearing width is therefore limited to the ½" (0.125"), i.e. 3.15 mm, width range. Using a bearing 3.15 mm (⅛") wide, seated in a bearing pocket in each yo-yo half, with the medial faces of the yo-yo halves set at 2.8 mm and with the intrusion of a starburst pattern snaring means raised 0.3 mm from each medial face, the effective string gap of the Amalar prior art is 2.2 mm.

[0059] By contrast, in the present invention, an increase of 10 per cent in the axial width of the bearing sleeve 10 or outer race of the bearing to 3.465 mm, in conjunction with non-intrusive snaring means 120, yields an increase in the effective string gap of 0.915 mm, or 42%. At a 20 per cent increase to 3.78 mm, again with non-intrusive snaring means, the effective string gap is increased to 3.43 mm, an
increase of 1.23 mm or 56%. It can be extrapolated that considerable gains are also made at differentials below 10 per cent, also within the scope of the present invention. By holding the axial width of the inner race and the ball race constant, there is no increase in friction.

[0060] The discussed range of settings was arrived at based on a standard eight ply 100% cotton string. The caliper of this string can vary depending on many string manufacturing factors, such as adjusting the tension between the string plies. An eight ply white string not under tension is approximately 1 mm in caliper. It follows that discussed the prior art does not envisage more than the primary string and one extra lay from a trick mount, such as “the elevator” (old school!), since at an effective string gap of 2.2 mm, a third thickness of string, making 3.0 mm of string thickness, would necessarily snap.

[0061] It is understood that the above description is intended to be illustrative and that other embodiments may be apparent to those skilled in the art without departing from the spirit of the present invention.

What is claimed is:

1. A yo-yo comprising:
   a pair of yo-yo halves;
   a connector axially extending between said halves and connecting said halves at central portions thereof;
   a roller bearing fixedly attached to the connector at a middle portion thereof;
   a spool having a concave outer surface generally symmetric about an axial midpoint and an inner surface fixedly attached to said roller bearing, said inner and outer surfaces being radially spaced to define a thickness, said concave outer surface having an axial width greater than said thickness and having a profile defining a slope which urges an attached yo-yo string toward the axial midpoint of said concave outer surface as said string winds about said spool during yo-yo play.

2. The yo-yo of claim 1 wherein at least one yo-yo half has an inner clinging surface adjacent said concave outer surface and wherein said clinging surface presents a tackiness which facilitates engagement with a yo-yo string.

3. The yo-yo of claim 1 wherein said roller bearing has an outer cylindrical surface with an axial width and said concave outer surface width is greater than said roller bearing width.

4. The yo-yo of claim 3 wherein said concave outer surface width exceeds said roller bearing width by at least 10% of the roller bearing width.

5. The yo-yo of claim 1 wherein at least one of said yo-yo halves further defines central recess for receiving end portions of said spool.

6. The yo-yo of claim 1, wherein the said spool further includes provision for a friction surface braking means.

7. The yo-yo of claim 6, wherein the friction surface is at least one O-ring.

8. The yo-yo of claim 1, wherein the effective outer race of the bearing has an effective outer race which comprises the major radial interval of the radius of the spool.

9. The yo-yo of claim 8, wherein the effective outer race of the bearing comprises a radial interval of more than fifty percent of the radius of the spool.

10. The yo-yo bearing member for a yo-yo comprising:

   a spool symmetric about an axis of rotation and having an inner cylindrical surface of axial length C and an outer string bearing surface defined between a pair of axially spaced ends each having an axially extreme circular edge having a radius greater than the distance from said axis to said string bearing surface, the axial distance D between said extreme edges being greater than the length C, said string bearing surface defining a concave profile of a surface of revolution about said axis and having a variable radial thickness t, the thickness of said profile relative to said edges being greatest at an axial midpoint and being generally symmetric relative to said midpoint and said length D being greater than said thickness t.

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