United States Patent

[11] **3,565,434**

[72] Inventor **James F. Liston**
866 Hare Ave., Ottawa 13, Ontario, Canada

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Continuation-in-part of application Ser. No. 497,019, Oct. 18, 1965, now Patent No. 3,467,385. This application July 10, 1969,

[54] **BOOMERANG WITH ADJUSTABLE-PITCH BLADES**
3 Claims, 14 Drawing Figs.

[52] **U.S. Cl.** **273/106**
[51] **Int. Cl.** **A63b 65/08**
[50] **Field of Search** ..... 273/106, 106 (3); 46/74, 156 (Inquired)

[56] **References Cited**

UNITED STATES PATENTS

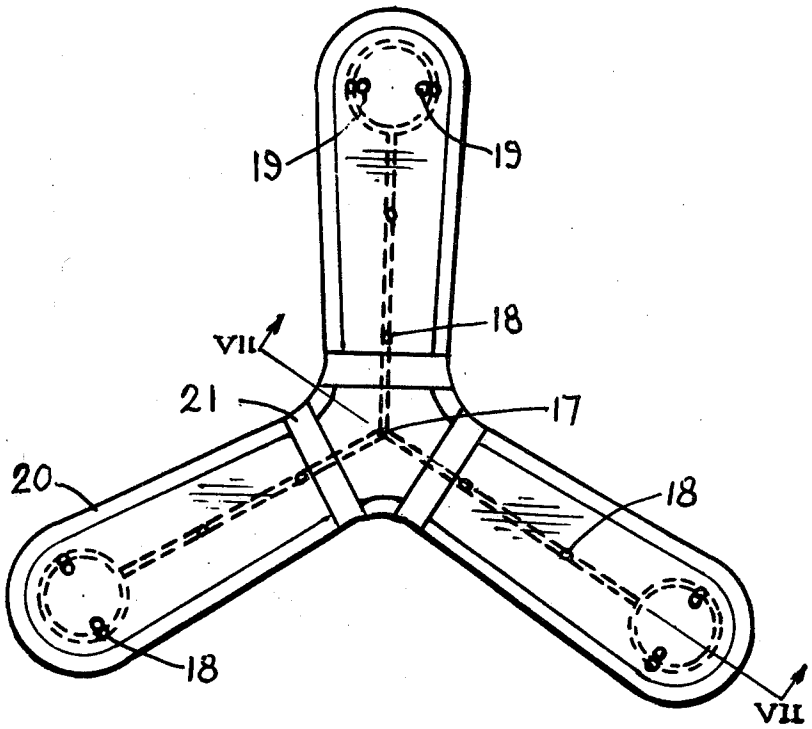
510,290	12/1893	Renear	273/106(3)
1,413,316	4/1922	Bradley	273/106
2,035,629	3/1936	Wing	273/106(3)
2,324,022	7/1943	Prause Jr.	273/106(3)
3,284,927	11/1966	Dahl	46/156

FOREIGN PATENTS

1,235,113	1960	France	273/106(3)

Primary Examiner—Richard C. Pinkham
Assistant Examiner—Paul E. Shapiro
Attorney—Otto John Munz

ABSTRACT: A malleable wire is moulded in the plastic blades of a boomerang along the neutral axis thereof. Twisting of the blades to exceed the yield point of the wire enables adjustment of the relative tilt of the blades. The blade ends are formed with weight-receiving pockets.



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SHEET 1 OF 2

Fig. 1.

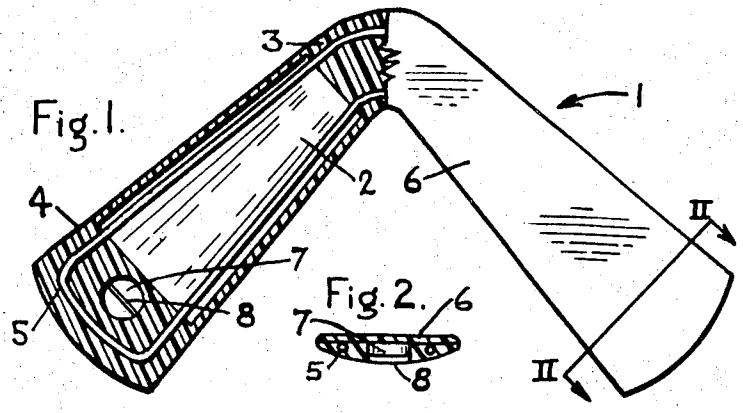


Fig. 2.

Fig. 3.

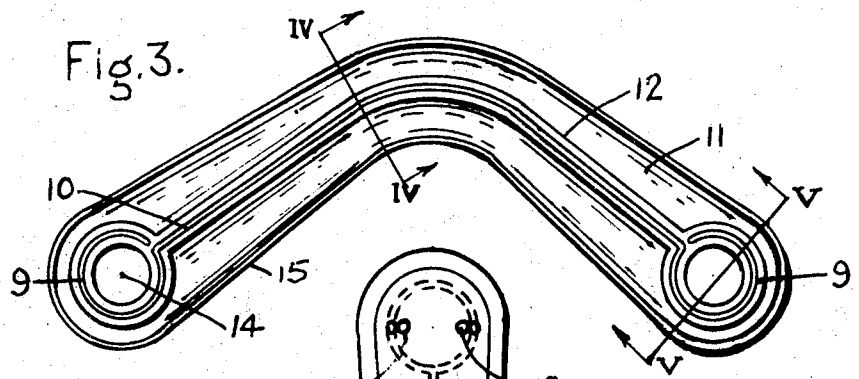


Fig. 4.

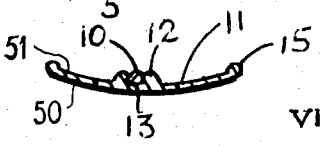


Fig. 5.

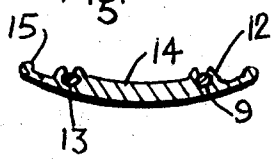


Fig. 6.

Fig 7.

INVENTOR
JAMES F. LISTON

BY Otho John Murray
ATTORNEY

Fig. 8.

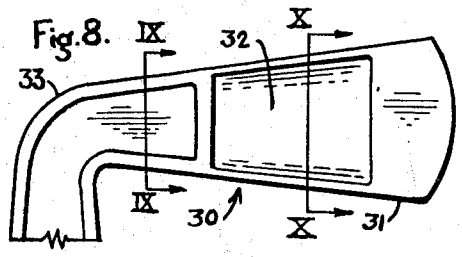


Fig. 9.

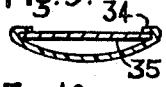


Fig. 10.

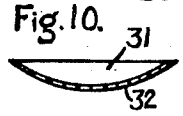


Fig. 11.

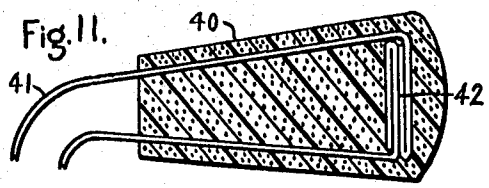


Fig. 12.

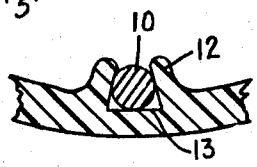


Fig. 13.

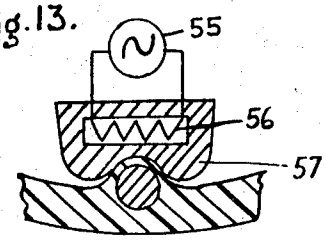
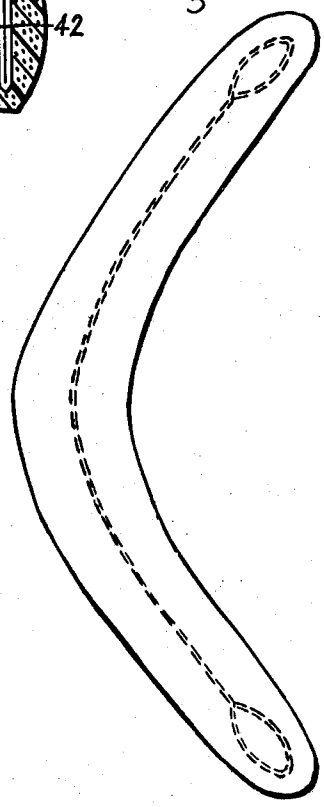


Fig. 14.



INVENTOR

JAMES F. LISTON

BY

ATTORNEY

BOOMERANG WITH ADJUSTABLE-PITCH BLADES

CROSS-REFERENCE TO RELATED APPLICATIONS

This is a continuation-in-part application to my original application, U.S. Ser. No. 497,019, filed Oct. 18, 1965, for a "-Boomerang" now U.S. Pat. No. 3,467,385 and the priority date to which the original application is entitled is claimed for all subject matter common therewith.

BACKGROUND OF THE INVENTION

Boomerangs are fascinating playthings, but their satisfactory operation depends upon critical relationships between their two blades, probably the most important relationships being between the pitch or tilt of the two blades, and between the related lift and drag of the blades and the weight of the boomerang. When constructing boomerangs of rigid material, such as the traditional ash wood, it is discouragingly easy to create an inoperable boomerang, which cannot be made operable merely by removing more material, and so it is scrap.

SUMMARY OF THE INVENTION

Boomerang flight is a combination of gliding with flywheel or gyroscopic action. In order to keep the boomerang airborne for a satisfactory length of time, the lift of the blades must be adequate to support the weight of the boomerang at the speed of rotation existing throughout the flight. The spin imparted in throwing diminishes steadily due to the drag of the air on the blades, but a rate influenced by the polar moment of inertia of the boomerang. A rigid boomerang must be designed and fabricated very accurately to be operable, since the only adjustment possible is to increase the polar moment of inertia by adding weights, as is well known in the art. However, this also adds to the weight that must be carried through the flight.

It is an object of the invention to make boomerangs with adjustable-pitch blades. Since the tilt of the blades for an operable boomerang is within the range of 0 to 5°, both lift and drag will be increased by an increase in tilt within this range. In the simplest models, this is the only adjustment provided.

Traditional boomerangs are primarily weapons, capable of flights of a hundred yards, and also capable of inflicting injuries. While certain variants of the invention are suitable for use in full size boomerangs, it is a further object to make light, flexible boomerangs with reduced-scale paths, suitable for use by city children in limited space and without danger to people or property.

A further object is to make light, flexible boomerangs cheap enough to be used as premiums, and to be practically indestructible in normal use.

It will be seen below that the objects of the invention are achieved by arranging at least two blades about a mutual center and interconnecting them with a permanently deformable structural element, such as malleable, ductile wire, aligned with the lengths of the blades. Twisting of the blades with mutually opposite twists may bring the wire past its yield point, thereby placing a permanent set which changes the relative tilt of the blades.

An important feature of the blades in the present invention is that they are made from material that is flexible. That is, all strain which they undergo is elastic and there is substantially no plastic yielding above a yield point. Such material is for instance moulded polyethylene. Because of this flexible property, airfoil shaping given the polyethylene blades during their moulding is substantially retained, even though the permanently deformable structural element has undergone plastic deformation above its yield point.

Other objects and many of the attendant advantages of this invention will be readily appreciated as the same becomes better understood by reference to the following detailed description when considered in connection with the accompanying drawings in which like reference numerals designate like parts throughout the FIGS. thereof.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partly sectioned plan view of a plastic boomerang moulded onto a wire frame.

FIG. 2 is a view on section II–III of FIG. 1.

FIG. 3 is a plan view of the concave side of a two-bladed boomerang of moulded plastic with a wire frame snapped into a groove provided for it in the moulding operation.

FIG. 4 is a cross section of FIG. 3 through section IV–IV.

FIG. 5 is a cross section of FIG. 3 through section V–V.

FIG. 6 is a plan view of a flying propeller with a wire frame moulded in.

FIG. 7 is a cross section through section VII–VII of FIG. 6.

FIG. 8 is a plan view of part of a moulded plastic boomerang with a sheet metal insert.

FIG. 9 is a view on section IX–IX of FIG. 8

FIG. 10 is a view on section X–X of FIG. 8.

FIG. 11 is a sectioned plan view of part of a foamed plastic boomerang moulded onto a wire frame.

FIG. 12 is a detail of FIG. 4.

FIG. 13 includes a FIG. 12 and a sealing iron.

FIG. 14 shows a shape variation of FIG. 3.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In the variant of FIGS. 1 and 2 the boomerang 1 comprises a pair of curved blades 2 tapering out from a solid center section 3 to larger solid tip sections 4. Wire frame 5 is embedded in the solid sections as shown, and covered by a flat skin 6. Each tip section may be provided with a weight well 7 into which tip weights may be inserted through a slit 8 in the skin 6 contiguous to the well 7. Any suitable weights, such as BB shot or washer slugs, may be used to weight the tips. Where polyethylene is used, sheet 6 will have to be welded on by heat. When other plastics are used, sheet 6 may be stuck on by suitable adhesive or solvent. Low density polyethylene is favored because of its toughness, resilience, and economy. No. 14 bright commercial steel wire is suitable for the frame.

In FIGS. 8, 9, and 10, boomerang 30 is moulded with heavy tips 31, of airfoil shape joined by the inner curved sections 32 to a central section 33, which comprises an angled corner with a curved cross section, the edges of this section being bent inwardly to form lips 34 retaining a sheet metal insert 35 firmly in place, as shown in FIG. 9. Of course, this variant could be finished with a welded-on skin like the boomerang of FIGS. 1 and 2, but it is cheaper to merely heat and deform the lips 34 over the edges of the insert. The insert may be of soft sheet iron of the order to .020 inch thick.

In FIG. 11, an airfoil blade 40 of strong foamed plastic, for example of 2 lb. per cu. ft. styrofoam known in the trade as Pelaspan, is moulded onto soft iron wire frame 41. An accumulation of wire 42 is formed at the tips, either by bending and resistance welding as shown, or by twisting the required amount of wire together, in order to provide enough weight in the tips to maintain a spin. To facilitate locating the frame in the die, crimps may be provided in the wire, which will engage the inner surfaces of the die when it is closed, but will appear in the finished product only as tiny spots in the surface of the plastic skin.

It will be observed that the three variants described above each comprises relatively soft, light, airfoil-shaped, plastic blades combined with structural elements of stronger material which may be deformed to change the tilt and thus the lift of the blades. The deformable structural elements are sufficiently rigid when deformed to resist deflection from their adjusted position during throwing and flight of the boomerang, Thus, the toy has the desirable qualities of the soft, resilient plastic, which is harmless and durable in use, rebounding from accidental collisions without damage to either the boomerang or the person or object contacted, and at the same time is capable of being adjusted accurately for perfect flights. This requires accuracy to a fraction of a degree, which could not be achieved merely by copying a conventional boomerang in moulded plastic.

The boomerang of FIG. 11 may be made in a further variant, more economical than durable, by enveloping the wire frame with a softer and more resilient foamed plastic such as foamed polyethylene, which is sufficiently flexible to withstand the twisting at the corner necessary in adjustment. Such a variant is cheap enough for use as a premium or as a very cheap toy, and will have as much durability as the public expects from a cheap toy.

The Pelaspan described above for use in the variant of FIG. 11 is, of course, too brittle to stand twisting, which is why the center is left bare. Failure of the foam plastic in use, of course, will not cause any hazard, since the wire frame is light and without sharp edges.

In the above-described variant of FIG. 8, which uses sheet metal inserts, there should be no skimping in covering the edges with an adequate thickness of plastic, to guard against any possibility of a metal edge becoming exposed during use.

The above disclosure relative to FIGS. 1, 2, and 8—11, being substantially identical to that disclosed in U.S. Pat. application Ser No. 497,019, **the status of continuation-in-part application is claimed therefor.**

In the variant of FIGS. 3, 4, and 5, the wire loops 9 are formed on the ends of a single wire 10, which runs substantially along the neutral axis of the boomerang. No displacement occurs along the neutral axis of the boomerang when the blades are twisted. This construction permits substantially unconstrained twisting of the wire and permits the moulded plastic to twist freely in response to a twist in the wire. As shown in cross-sectional FIGS. 5 and 4, boomerang 11 is moulded with a convex side 50 and a concave side 51. Ridge 12 protrudes from the center of the concave side and is provided with a groove 13 having a dovetail cross section, as shown in FIG. 12. This dovetail cross section provides a snap-in fit for the wire 10 and its loops 9. The tips 14 within the loops 9 are thickened somewhat to increase the polar moment of inertia and prolong the spin of the boomerang in use. The loops themselves are accumulations of wire that also increase the polar moment of inertia. The loops also serve the purpose of levers for twisting the wire 10.

A small peripheral lip 15 may be added to improve rigidity and durability, In order to avoid the production problems involved in placing wire 10 in a hot mould, the plastic part may be moulded and cooled without the wire, after which the wire is snapped into the groove. This has been found to give a satisfactory product, if proper tolerances are maintained. However, if absolute security is desired, as shown in FIG. 13, a sealing iron 57, heated by element 56 connected to voltage source 55, may be used to melt the material of the ridge 12 over the wire after its insertion in the groove 13 to seal it therein. This extra step also results in a smoother surface on the concave side of the boomerang, and somewhat improved airflow. An operable size of the variant of FIGS. 3, 4 and 5 is about a foot long, and a thickness, exclusive of ridge, of .040 to .050 inch, and having a weight with the wire inserted of approximately 1¼ ounce. Such a boomerang will perform well in a normal breeze. Substantially lighter models will fly more easily for small children, but will be blown long distances by a brisk breeze. This particular model is designed for use in a city where large spaces are not available.

FIGS. 6 and 7 show a flying propeller also having its blade tips firmly attached to wire loops whose straight portions are connected together at a central point. In order to show an alternative construction, the wires are illustrated as moulded into the plastic instead of being snapped into premoulded grooves. In order to locate the frames centrally in the mould, crimps 16 are provided as necessary. In the example shown, two crimps are made in each loop and two in each straight section of wire. As shown in FIG. 7, intersection 17 may be formed by bending one wire to make two arms of the frame and then welding on the third arm at the intersection. In order to locate the loops accurately, a pair of pins may be provided in one half of each die for each loop, which will result in a pair of blind holes 19 showing on one surface of the moulded propeller. The tips of the crimps may also show at the surface, as shown at 18. These surface imperfections are not objectionable, and do not detract from the toy's performance. As shown in FIG. 7, the crimps protrude from the plane of the wire alternately back and forth one-half the thickness of the blades.

The most economical material for moulding for according to the design of FIGS. 6 and 7 is styrofoam. However, styrofoam is somewhat brittle, and in order to prevent cracking in use, a wrap of adhesive tape 20 may be added around the periphery. Where the tape follows a concavity, as at the central section, additional wraps 21 are added to prevent the tape around the periphery from pulling away. Since children are notoriously fond of taping things, these toys may be sold as moulded along with a small roll of tape of the child's favorite color, and taping instructions included. Colored vinyl tape is most suitable, although cheaper tapes are available.

A practically indestructible toy can be moulded of urethane foam or foam rubber using the design of FIGS. 6 and 7. Besides being more durable than styrofoam without any further protection, these materials can be coated with economical, fast-drying, tough-coating compositions known in the art.

While the design using a frame snapped into a groove after moulding has been described with relation to a two-bladed boomerang, and the design with a moulded-in frame has been shown as a three-bladed propeller, it will be obvious that either design is suitable for either two-bladed boomerangs or flying propellers with three or more blades. For four blades, two wires with loops at their tips may be welded together at their centers either as crossed straight lines or as abutted bent wires.

It should be understood, of course, that the foregoing disclosure relates to only preferred embodiments of the invention and that it is intended to cover all changes, modifications and combinations of the invention herein chosen for the purposes of the disclosure, which do not constitute departures from the spirit and scope of the invention set forth in the appended claims.

The status of continuation-in-part application is claimed for the disclosure of FIGS. 3—7.

In the plane of the drawing, FIGS. 1, 3, 6, 8, and 11 show the blades widening with increasing distance from their mutual centers. However, the opposite, traditional shape can also be used, as shown in FIG. 14.

I claim:

1. A boomerang comprising a plurality of flexible blades arranged about a mutual center, a permanently deformable element extending between the blades, through the center, whereby twisting of the blades may permanently deform the structural element to adjust the tilt of the blades, a solid center section (3) at the mutual center, the blades extending out from said center section and including solid sections (4) at their extremities and a skin (6) covering and attached to said solid sections (3 and 4), the deformable structural element comprising a wire frame (5) embedded in said solid sections and covered by said skin.

2. A boomerang as claimed in claim 1, including weight-receiving wells formed in solid sections (4), at the blade extremities said skin (6) having slits (8) contiguous to said wells whereby weights may be inserted and removed.

3. A boomerang comprising:

a plurality of soft resilient blades arranged about a common center;

a permanently deformable structural element extending between the blades, through the center, whereby twisting of the blades may permanently deform the structural element to adjust the tilt of the blades; and

said deformable element being a single wire (10) having looped ends (9), said blades being integrally connected at their common center, said wire following substantially along the neutral axis of said blades.