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(54) SELF-ALIGNING TOY CAR USING INERTIAL ENERGY

(57) The toy vehicle (1) consists of an upper body (2) and a chassis (3) between which an inertia ball (5) is trapped which rolls over the surface (8) when the toy vehicle (1) is briefly pushed manually.

The kinetic rolling energy accumulated in the inertia ball (5) is transmitted after the chassis (3) is pushed by one or two points of contact which the inertia ball (5) has on the front edge of a polygonal opening (4) in the chassis (3) which is positioned in front of the vehicle's centre of resistance, defined by the friction forces acting on the wheels (6).

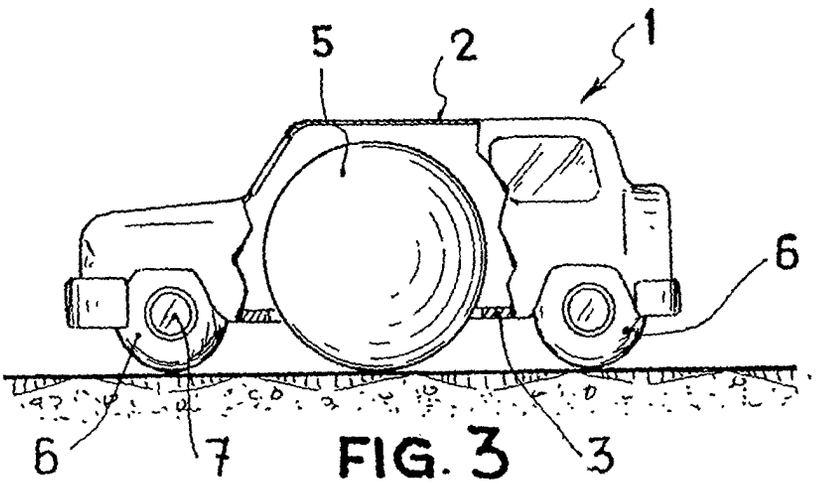

FIG. 3

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Description

[0001] This invention refers to a toy vehicle which, when it is pushed, momentarily drives a high-inertia element which returns the energy stored in it when the exterior push is completed. The vehicle has the high-inertia device positioned in such a way as to reduce the friction losses therein, as well as conferring the vehicle with self-alignable features which are improvements on known embodiments.

[0002] The use of inertia balls and wheels in toys has been known for a long time. In 1905, US patent 800,741 disclosed a toy consisting of a hollow figure representing a dancing couple with a ball trapped inside it. This makes the figure freely rotate and move in all directions when it is positioned on a plane which is inclined in one direction or the other. This makes use of the high degree of freedom derived from the spherical shape of the ball, but is unaware of the possibilities that could be derived from a heavy ball. The toy is not designed to be pushed by the hand, and this is confirmed in the drawings, which show that the ball is made from glass, and not metal.

[0003] Document US 4,156,986 describes a small, very economic, toy vehicle, designed to be added to cereal packets as a gift, manufactured in injected plastic, containing a high-inertia disk therein which rotates around a transversal axis while it is rolling along a surface. Once the vehicle has been push-started, the movement continues for longer than it would should the vehicle not have the high-inertia rotating disk. This solution involves two basic problems: in the first place, since the axis of the rotating disk is fixed, this means that its height above the surface is also fixed, which in turn means that either the front or the rear wheels will not be on the ground, reducing steering capacity; secondly, the fact that the disk's rotating axis is fixed means that recoverable energy is diminished when the vehicle is pushes in a direction forming an angle with its front-rear axis. In other words, if the vehicle is pushed in a direction which is not that of its own axis, there is nothing to force it to change direction and its performance is considerably reduced.

[0004] The above problem is partially solved in US 6,071,173 and ED 200100154U, the latter presented by this applicant, in which the fixed axis rotating disk is replaced by a simple metal ball bearing trapped in the hollow structure of the vehicle. The American document contemplates a circular wall to support the ball, which generates a reaction on the vehicle moved in the direction of the movement and applied to the height of the ball's centre of gravity which, in theory, allows the front of the vehicle to move in the direction of the movement, with a certain degree of self-alignment. On the other hand, the Spanish document discloses a vehicle in which the circular wall supporting the ball is simply eliminated, although there is a circular hole in the vehicle's chassis, which diminished the self-alignment features but slightly reduces the friction losses.

[0005] The applicant's experience with the vehicle thus disclosed has shown that, surprisingly, when the ball inertia/vehicle weight ratio changes considerably, its self-alignment features also change. When the ball's inertia is not very high in relation to the weight of the vehicle, there is clear interest in the vehicle resting on a circular surface, since this generates a couple of forces which moves the front of the vehicle in relation to its centre of rotation, which is at an intermediate point between the rear wheels. The explanation lies in the fact that it is the vehicle itself (heavier) which determines the principal path, with the ball merely exercising a lateral reaction to the front thereof. However, when the ball's inertia is considerably greater than the weight of the vehicle, the principal path is determined by the ball, and it is the vehicle that rotates around it, with the front and the rear moving simultaneously. In these conditions, the vehicle's movement depends on the position of its centre of resistance (defined by the friction of the wheels) in relation to the inertia ball.

[0006] Thus, one objective of this invention is a toy vehicle running on inertia with improved self-alignment features, with high inertia and low friction losses.

[0007] The objective proposed is achieved in the vehicle of the invention by the positioning of a trapped ball, of considerable inertia in relation to the weight of the vehicle, inside the cavity formed by the upper body and the lower chassis; this ball rolls freely over the surface on which the toy vehicle is positioned. The opening in the vehicle's chassis, through which the ball can be seen, is a straight sided polygon, this replacing the linear contact of the prior art with one or two points of contact. The polygonal opening is in front of the vehicle's centre of resistance, defined as the virtual point of action resulting from the different friction forces derived from the weight of the wheels on the surface plane.

[0008] Should the weight of the vehicle, not including the inertia ball, be distributed 50:50 between the front and rear wheels, with all the wheels having the same diameter and width, the centre of resistance will be on the intersection of the bisections of the rectangle defined by the points of contact of the wheels on the surface. Otherwise, the centre of resistance will move towards the wheels which support a greater percentage of the vehicle's weight or, in general, have greater friction, which can be modified by altering the width and roughness of the wheels. The vehicle's centre of resistance can be evaluated by calculations or, preferably, by empirical testing. The choice of the distance between the point of contact of the ball with the surface and the centre of the polygonal opening will depend on the degree to which it is desired for the toy vehicle to be manoeuvrable. The vehicle's characteristics can easily be modified, depending on whether it is a sports car or a heavy goods trailer, for instance.

[0009] To complete the above description, and to make it easier to understand the characteristics of the invention, we will provide a detailed description of a pre-

ferred embodiment, based on the attached set of drawings which, in an illustrative but non-restrictive manner, show the following:

Figure 1 shows a diagram of the forces acting during self-alignment, as have been seen in vehicles manufactured using the previous technique.
Figure 2 shows a diagram of the forces acting during self-alignment, as have been verified in the vehicle manufactured according to the invention.
Figure 3 shows a cross section of the vehicle of the invention.

[0010] The numerical references correspond to the following parts and components:

1. Toy vehicle
2. Upper body
3. Chassis
4. Polygonal opening
5. Inertia ball
6. Wheels
7. Wheel shafts
8. Surface
9. Circular wall

[0011] Figure 1 shows the diagram of force and movement produced during the self-alignment of a vehicle manufactured according to the prior art. Thus, the relatively heavy vehicle will determine the principal path after being pushed by hand. The inertia ball (5), acting on the circular wall (9), generates a force R1 which causes a movement M1 which tends to move the front of the vehicle in the direction of the movement, causing the vehicle to rotate in relation to a centre of rotation 0 which, in these conditions, is between and near to the rear wheels. The movement is quite sudden and not very natural, and it causes high losses derived from friction between the inertia ball (5) and the circular wall (9).
[0012] In the vehicle of the invention, the inertia ball (5) is trapped between an upper body (2) and a chassis (3) in which there is a polygonal opening (4) through which the inertia ball (5) can roll on the surface (8), but through which it does not pass when the vehicle (1) is lifted from the surface (8). See figure 3.
[0013] When the vehicle of the invention is pushed in a direction other than that of its front-rear axis, the path will be defined and maintained, principally, by the inertia ball (5), since we have assumed that, in relation to the latter, the vehicle is quite lightweight. Consequently, as shown on figure 2, the vehicle will undergo a resulting force R2 applied to its centre of resistance O due to the friction forces F which appear on each of its wheels (6), which causes a rotating moment M2 which acts on the vehicle, simultaneously moving both its front and its rear around the inertia ball (5), which continues its path undisturbed. The intensity of reactions will depend on the absolute value of the resulting force R2 and the distance "d" between the point of contact of the inertia ball (5) on the surface (8) and the centre of resistance O, which can be varied at will. Figure 2 has assumed that the weight is distributed 50/50 between the front and rear wheels which, on the other hand, corresponds to a concept which is passionately defended by certain actual car manufacturers.
[0014] With regards to the industrial embodiment, the inertia ball (5) will have to be inserted between the upper body (2) and the chassis (3) before being joined by any known method, and the wheels can be installed rotating on the corresponding wheel shafts (7) or fixed, and merely decorative, forming part of the upper body (2) or the chassis (3), which will reduce the cost of the product considerably.
[0015] For someone skilled in the art, a series of possible variations and modifications will be evident, providing the essence of the invention is maintained. Thus, the figures show a polygonal opening (4) in the form of a hexagon, which has been seen to be an optimal solution, but it could equally be square, triangular or with more sides, although in this case we lose the advantages of low friction the nearer we come to a circle.

Claims

1. Self-alignable toy vehicle with inertia energy, **characterised in that** it consists of an inertia ball (5) lodged and trapped in an upper body (2), able to roll over a surface (8) when movement is initiated manually, and when the movement ceases, it communicates its kinetic rolling energy to the toy vehicle (1) by means of the edge of a polygonal opening (4) with a chassis (3) which closes the bottom of said upper body (2), with the polygonal opening (4) located in front of the vehicle's centre of resistance.

2. Self-alignable toy vehicle with inertia energy, according to claim 1, **characterised in that** the polygonal opening is a hexagon.

3. Self-alignable toy vehicle with inertia energy, according to claim 1, **characterised in that** the weight of the vehicle, without including the inertia ball (5), is equally distributed between the front and rear wheels.

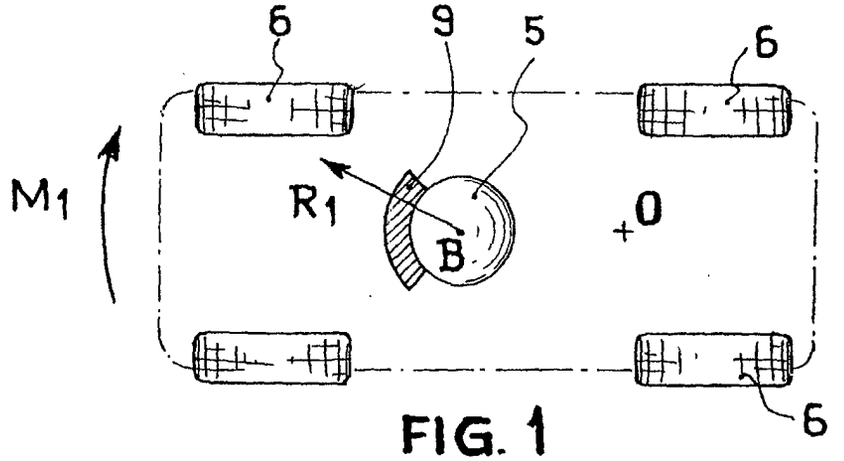

FIG. 1

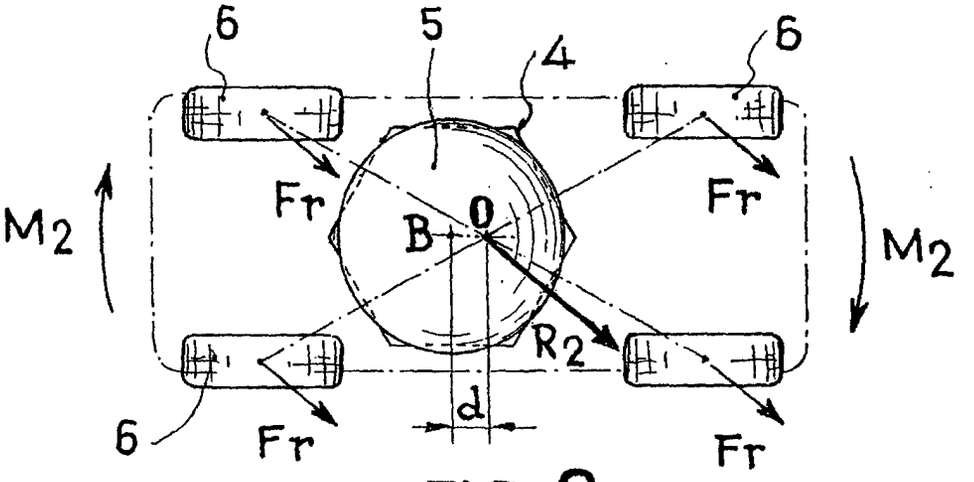

FIG. 2

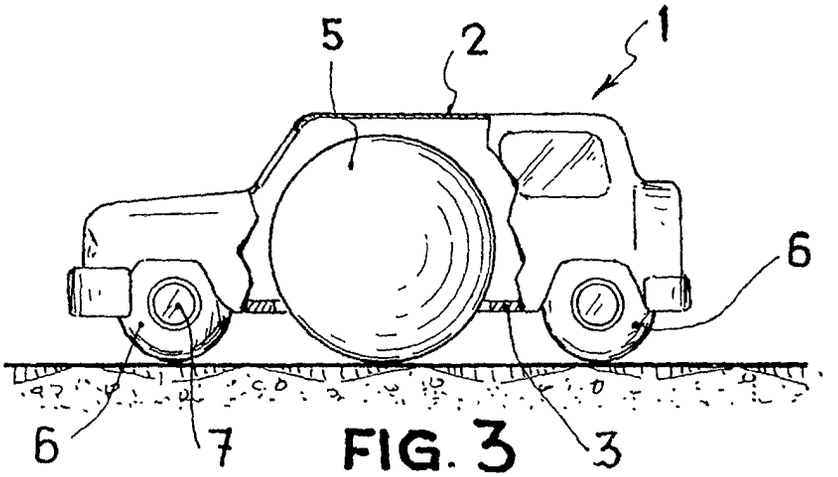

FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/ ES02/00150

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 A63H29/08,17/00

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)

IPC 7 A63H+, A63F+

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)

CIBEPAT, EPODOC, WPI, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 6071173 A (KELLEY) 06.06.2000, column 1, line 48- column 2, line 57; figures	1,3
A	FR 794261 A (GILAZ) 12.02.1936, **the whole document**	1
A	DE 1074467 B (PAESSLER) 28.01.1960, columns 1-2; figures	1
A	US 4156986 A (KUPPERMAN et al.) 05.06.1979, column 2, line 43- column 3, line 22; figures 5,6	1
A	DE 485351 C (EMMERT) 31.10.1929, **the whole document**	1

☐ Further documents are listed in the continuation of Box C. ☒ 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

"E" earlier document but published on or after the international filing date

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"P" document published prior to the international filing date but later than the priority date claimed

"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

"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

"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

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
31 MAY 2002 (31.05.02)	**07 JUNE 2002 (07.06.02)**
Name and mailing address of the ISA/ **S.P.T.O.** Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/ES02/00150

Patent document cited in search report	Publication date	Patent familiy member(s)	Publication date
US 6071173 A	06.06.2000	NONE	
FR 794261 A	12.02.1936	NONE	
DE 1074467 B	28.01.1960	NONE	
US 4156986 A	05.06.1979	NONE	
DE 485351 C	31.10.1929	NONE	

Form PCT/ISA/210 (patent family annex) (July 1992)