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3,483,654

UNDERCARRIAGE FOR TOY VEHICLES

Filed Nov. 20, 1968

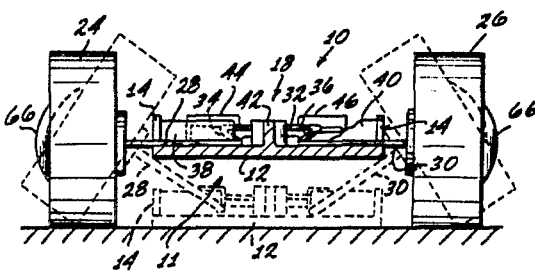
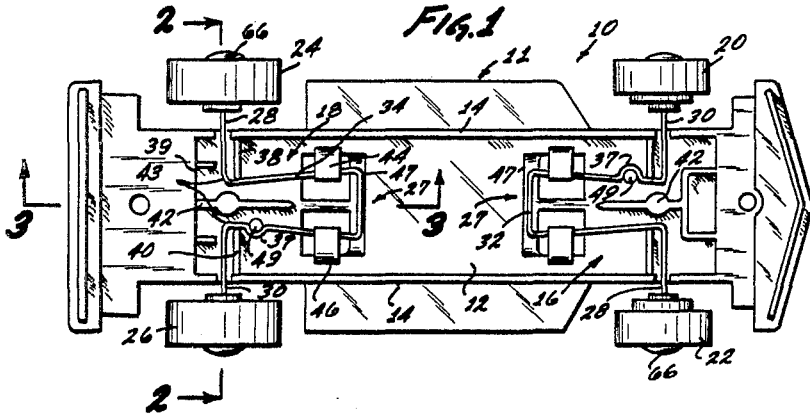


FIG. 2

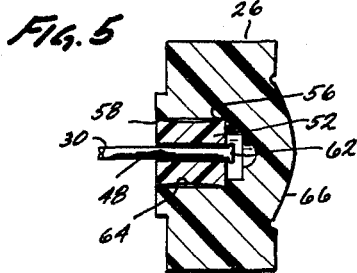


FIG. 5

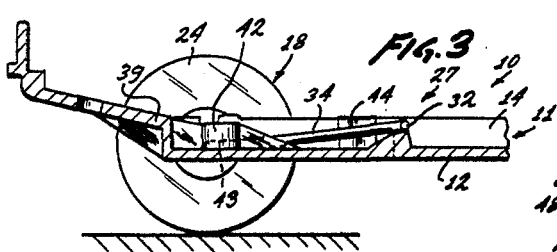


FIG. 3

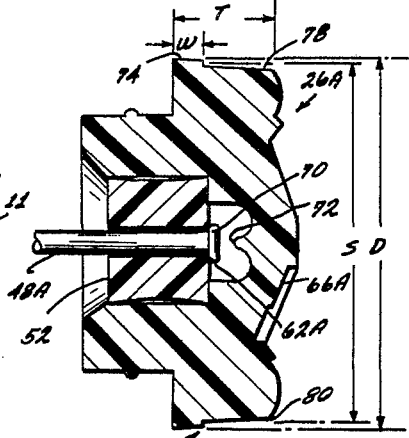


FIG. 6

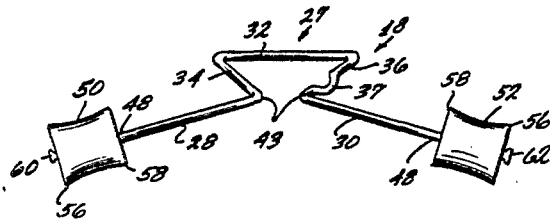


FIG. 4

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**UNDERCARRIAGE FOR TOY VEHICLES**

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Continuation-in-part of application Ser. No. 696,199,  
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No. 777,284

Int. Cl. A63h 17/26

U.S. Cl. 46—201

17 Claims

**ABSTRACT OF THE DISCLOSURE**

A low friction toy vehicle with wheels rotatably mounted on the axle, wherein the wheel hub has an inwardly projecting boss that can bear on the center of the axle end to provide a low friction thrust bearing. The wheels include a narrow rim portion having a slightly greater diameter than the rest of the rim, to provide low road friction while maintaining the appearance of a wide tire.

**CROSS REFERENCE TO RELATED APPLICATION**

This application is a continuation-in-part of patent application Ser. No. 696,199, by Harvey W. La Branche and Howard F. Newman filed Jan. 8, 1968.

**BACKGROUND OF THE INVENTION**

The background of the invention will be set forth in two parts.

**FIELD OF THE INVENTION**

The present invention pertains generally to the field of toy cars and more particularly to an improvement in the undercarriage for a toy car.

**DESCRIPTION OF THE PRIOR ART**

Toy car constructions which employ a pair of rigid axles snapped onto the bottom of the chassis of the car are well known. Wheels are rotatably mounted upon the ends of each of these axles. Such axles have a disadvantage that they do not permit resilient wheel mounting, and thus lack authenticity. Another disadvantage resides in the fact that the rigid axle must have a comparatively large diameter to prevent the axle from bending beyond its yield point when the car is subjected to a downward force during play. Such large diameters result in excessive frictional drag between the wheels and their associated axles.

Such prior art patents as United States Patents Nos. 2,749,662; 3,009,287 and 3,280,500 suggest to mount such rigid axles in slots and permit the axles to deflect upwardly under the influence of spring means in an attempt to gain a certain degree of authenticity. However, the constructions disclosed in these patents have the disadvantages that they are comparatively expensive to manufacture and assemble and that the axles are of a comparatively large diameter resulting in excessive frictional drag.

**SUMMARY OF THE INVENTION**

In view of the foregoing factors and conditions characteristic of toy car constructions, it is a primary object of the present invention to provide a new and improved toy car construction not subject to the disadvantages enumerated above and having an undercarriage including axle means especially designed for minimizing frictional drag economically.

Another object of the present invention is to provide an improvement in an undercarriage for a toy vehicle including axle means having at least one pair of small-

diameter axle shaft portions substantially co-axial with each other and being connected to torsionally-resilient member means facilitating movement of the axle shaft portions with respect to the vehicle body by torsion deformation of the member means.

Still another object of the present invention is to provide an undercarriage of the type described wherein the wheels are resiliently mounted with respect to the undercarriage to provide authentic springing.

Still another object of the present invention is to provide resiliently mounted wheels upon the undercarriage of a toy car which has sufficient displacement with respect to the undercarriage that the top of the wheel may bottom out against the fender opening surfaces of the car without exceeding the yield point of the axles.

A further object of the present invention is to provide a pre-stressed, U-shaped torsionally-resilient member means and axle combination for mounting upon the undercarriage of toy cars so that the wheels are not deflected with respect to the undercarriage by the normal car weight.

Another object of the present invention is to provide wheel mounting means for mounting wheels upon the axles of a toy car wherein a hub is mounted on the end of an axle and a wheel is resiliently snapped onto the hub.

According to the present invention, an improvement is provided in an undercarriage in a toy vehicle body including axle means and wheel means rotatably mounted upon the axle means. The axle means has at least one pair of axle shaft portions substantially co-axial with each other and each having an outboard end receiving an associated one of said wheel means and an inboard end. A torsionally-resilient member means is connected to each of the inboard ends and the torsionally-resilient member means is connected to the vehicle body in such a manner that the axle shaft portions are movable with respect to the body by torsion deformation of the member means without substantial bending deformation of the axle shaft portions. Frictional drag on the wheels is minimized by making the axle shaft portions of a much smaller diameter material than is usually employed in toy cars. By way of illustration, but not of limitation, the axle shaft portions may be made from a 20 thousandths, 0.8% carbon content, extra-high strain mandolin wire tinned and torsion straightened.

A pair of axle shaft portions and their associated torsionally-resilient member means may be formed from a single piece of wire having a bight portion connecting the member means together forming a U-shaped member therewith. The axle shaft portions extend somewhat downwardly from the U-shaped member. The resulting assembly is secured to the top of the undercarriage in such a manner that it is stressed into a substantially planar position so that the axles are stressed in such a manner that the axle shaft portions assume a substantially horizontal position making all four wheels lie in the same plane. The axle shaft portions may be moved with respect to the body until the body bottoms out on a surface supporting the wheel means without exceeding the yield point of the axle shaft portions or the torsionally-resilient member means.

Wheel mounting is accomplished by rotatably mounting hubs upon each axle. The hubs are retained from movement off of the ends of the axles by swaging the axle ends. The wheels resiliently snap onto these hubs. Each wheel carries a simulated hub cap which is closed over the hub so that the simulated hub cap prevents inward motion of the wheel on the axle by engagement with the end of the axle.

Each axle means may be quickly assembled to a vehicle by snapping the axle means in place. This, coupled with the one-piece construction from comparatively small-

diameter material, results in an advantageous structure with little more cost than disadvantaged prior art structures.

In one embodiment of the invention, frictional drag on the wheels is minimized by providing an inwardly-directed rounded protuberance on each wheel that can bear against the axle end to serve as a thrust bearing. The swaged ends of the axles are provided with a flat outer face, while the protuberance is positioned to bear against the center of this face. To further reduce friction, the perimeters of the wheels are formed with only a narrow rim portion of full diameter that contacts the roadway, but which still gives the appearance of a wide tire of the type generally used on automobiles.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. The present invention, both as to its organization and manner of operation, together with further objects and advantages thereof, may best be understood by reference to the following description, taken in connection with the accompanying drawings in which like reference characters refer to like elements in the several views.

#### BRIEF DESCRIPTION OF THE DRAWING

FIGURE 1 is a top plan view of a toy vehicle frame employing an undercarriage of the present invention;

FIGURE 2 is an enlarged, cross-sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a partial cross-sectional view taken along line 3—3 of FIGURE 1;

FIGURE 4 is an enlarged perspective view of a wheel-suspension means and associated wheel hub forming a part of the vehicle shown in FIGURE 1;

FIGURE 5 is an enlarged cross-sectional view of a wheel and axle assembly forming a part of the vehicle shown in FIGURE 1; and

FIGURE 6 is an enlarged cross-sectional view of a wheel and axle assembly constructed in accordance with another embodiment of the invention.

#### DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring again to the drawings, a toy vehicle constituting a presently preferred embodiment of the invention, generally designated 10, includes an undercarriage 11 having a frame 12 which is generally planar on its underside, as is shown in FIGURE 2. If desired, the underside can carry a design configuration which represents the bottom view of a conventional automobile. Upstanding flanges 14 are formed around the edge of frame 12 to strengthen it and to also conveniently serve as a means for interlocking with a toy car body (not shown) which may be mounted on the top of frame 12. Alternatively, frame 12 may form an integral part of a car body. Front axle means 16 and rear axle means 18 are mounted on the top of frame 12. Front axle means 16 carries front wheel means 20 and 22 while rear axle means 18 carries rear wheel means 24 and 26.

Front and rear axle means 16 and 18 are identical in their configuration and identical in the mounting upon frame 12. For purposes of convenience, only rear axle means 18 will be described in detail, it being understood that the description also applies to the front axle means and its mounting.

Axle means 18 is formed with a U-shaped center portion 27 and axle shaft portions 28, 30 extending therefrom. The U-shaped center portion 27 has a base or bight 32 which is preferably substantially straight. Sides or torsionally-resilient member means 34, 36 extend away from base 32, and preferably are directed somewhat toward each other at an acute angle, as is shown in FIGURE 1. Axle shaft portions 28, 30 are positioned on the ends of sides 34, 36, respectively, and extend laterally

past the sides of frame 12. Side 36 preferably has a loop 37 formed therein to serve as a locating means upon assembly as is hereinafter described.

The entire rear axle means 18 is more of a unitary structure, preferably by being made from 0.8% carbon content, extra-high strain mandalin wire which has been tinned and torsion straightened. Furthermore, in the unstressed condition, axle shaft portions 28, 30 are directed slightly downwardly from the plane defined by base 32. The general shape in the unstressed condition is shown in FIGURE 4. The amount of this deflection in the unstressed state from the reference plane of base 32, in conjunction with the resiliency and size of the material from which rear axle means 18 is made, determines the amount of force which must be applied to the axle when it is in its mounted position, before it is deflected.

As is illustrated in FIGURES 1, 2 and 3, the top of frame 12 is generally planar, and extending up from the planar top surface are the peripheral flanges 14. In addition, transverse flanges 38, 39 and 40 extend upward from the plane of the top of frame 12. Flanges 38 and 40 are directed toward each other, but terminate short of each other. Flanges 38 and 40, in conjunction with flange 39, define spaces in which lie axle shaft portions 28, 30. Thus these flanges restrain these axle shaft portions 28, 30 from substantial forward or rearward motion. In addition, a boss 42 lies between the inboard ends 43 of axle shaft portions 28, 30 to keep them separated, while the transverse flanges 38 and 40 terminate closely adjacent to the outer sides of sides 34 and 36. Thus, axle shaft portions 28, 30 are restrained from substantial axial motion. Hooks 44 and 46 are preferably integrally formed with frame 12 and are positioned to extend over the top of sides 34 and 36 to retain base 32 against a wedge 47 on the top surface of frame 12. The raising of base 32 away from the general plane of the top surface of frame 12 stresses sides 34 and 36 so that the junctures of these sides with axle shaft portions 28, 30 lie against the top surface. Thus, upward loads upon the wheels cause rotation of the axle shaft portions 28, 30 about their inboard ends 43. Rotation at this point causes torsion deformation in the sides 34 and 36 and it is this torsion deformation that provides the principal amount of resilient deflection for the wheels.

Since the sides 34 and 36 are restrained against the planar top of frame 12, axle shaft portions 28, 30 are forced into a position wherein they are co-axial. Thus, the axle means 18 is restrained so that the axle shaft portions 28, 30 cannot move to the unstressed position of FIGURE 4, but are maintained so that they cannot move below the planar position. By this means, the axle shaft portions are resiliently restrained in a coaxial position, as is illustrated in solid lines in FIGURE 2. When upward force is applied to the ends of the axle shaft portions, the pre-stress of the axle means must be overcome before deflection occurs. This stress is such that under the ordinary weight of the toy car, no deflection occurs, but upon the application of further downward force, the outboard ends 48 of axle shaft portions 28, 30 can be resiliently displaced upward. The retention of sides 34 and 36 is such that during this displacement, they continue to lie against the top of planar surface of frame 12, but sides 34 and 36 twist in torsion. The amount of permissible displacement of the ends 48 of the axle shaft portions is such that the axle means 18 is not over-stressed when deflections move the bottom of frame 12 into the same plane as the bottoms of the wheels, as shown in broken lines in FIGURE 2. Thus, the yield point of axle means 18 is not exceeded even when the undercarriage is bottomed.

Since the axle means should be correctly assembled onto the frame, in view of the unstressed shape of the axles, a pin 49 is formed on top of frame 12. When the axle is correctly positioned on the frame, loop 37 embraces pin 49. If an attempt is made to insert the axle means in the

incorrect position, side 34 would engage upon pin 49 and thus completion of assembly would be prohibited.

Referring to FIGURES 4 and 5, hubs 50 and 52 are respectively positioned upon the ends 48 of axle shaft portions 28, 30. Hubs 50 and 52 each have an opening therethrough to be rotatable on their respective axle shaft portions. Furthermore, hubs 50 and 52 are preferably made of a synthetic polymer composition material of such nature that they are somewhat resilient and are slightly concave so that they are formed with slight ridges 56, 58 to retain the wheels in position thereon. Hubs 50 and 52 are maintained on their respective axle shaft portions by swaged knobs 60 and 62 formed on ends 48 thereof after the installation of the hubs.

As is seen in FIGURE 5, wheel 26 has a hub bore 64 therein. Preferably, wheel 26 is also made out of synthetic polymer composition material so that it is somewhat resilient. Hub bore 64 is of such diameter that, by resilient deflection, wheel 26 can be passed over and snapped over ridges 56, 58 which maintain wheel 26 in position. A simulated hub cap 66 is formed on the outside of wheel 26 and acts as an axle stop. Knob 62 engages upon the inside surface of the hub cap 62 to prevent the wheel and hub cap assembly from substantial inward motion upon the axle shaft portion 30. It is understood that the construction of each of the wheels 20, 22, 24 and 26 is described with respect to FIGURE 5 with the possible exception of the size and external shape of the wheel itself. This wheel construction permits the rapid assembly and firm retention of the wheels upon undercarriage 11.

FIGURE 6 illustrates another embodiment of the invention constructed for a further reduction of frictional drag on the wheels. This embodiment of the invention is identical to the vehicle described above except for the construction of the ends of the axle shaft portions and the wheels. In particular, the shaft portion 48a has an extreme outer end or boss 62a having a flat outer face 70, and the wheel 26a has a protuberance 72 that can bear against the center of the boss, to provide a thrust bearing of low friction. In addition, the wheel 26a is provided with a narrow rim portion 74 to provide low roadway friction, and yet maintain the appearance of a wide tread tire of the type generally used on modern automobiles.

One source of vehicle drag results from frictional contact between the boss 62a at the end of the axle, and the wheel hub cap portion 66a that serves to limit inward wheel movement. While the boss and wheel hub portion may be in contact only part of the time, the added friction by poor thrust bearing construction can add significant drag. This is particularly true where other sources of friction have been minimized, as by use of a small diameter axle for engaging a radial bearing provided by the hub 52.

The boss 62a and wheel hub cap 66a are constructed to provide a minimum of friction when they are in contact, by providing for contact at the center or axis of the axle. The axle center is where any friction produces the least counter-torque. By making the face 70 of the axle end flat, and providing the inwardly-directed, rounded projection or protuberance 72 on the inner surface of the outer side of the wheel at the hub cap portion 66a, contact can be maintained stable near the axis of the axle. The face 70 can also be provided with a slight concavity to help maintain contact at the center. Instead of a rounded protuberance, a straight tapered protuberance or other shape can be employed. However, the extreme inner end of the protuberance should have a surface area of contact which is much smaller than the surface area of face 70.

Road friction is reduced by the use of a narrow outer rim portion 74, which has a width W less than half the total width T of the wheel rim 76. The outer rim portion has a diameter D which is only slightly greater than the greatest diameter S of the other portion 78 of the rim.

The greater diameter D results in a narrow road-engaging portion or footprint, to provide for low road friction could be achieved by merely using a thin wheel, this would detract from the appearance of the wheel, which is made to simulate the wide tread tires generally used in modern automobiles. However, by using a wide wheel, with all portions of almost full diameter, and all having the same color, such as black, the wheel has a wide tread appearance. For relatively hard rims, the diameter D can be made only a few percent greater than the diameter S to achieve low road friction. So long as the diameter D is no more than about 10% greater than diameter S, the departure from a constant diameter is not easily noticed. The portion 78 is preferably provided with a slight taper between a section adjacent to rim portion 74 and a section furthest from it, so that, even if the wheel is tilted slightly, the outer ridge 80 is unlikely to contact the roadway.

Although particular embodiments of the invention have been described and illustrated herein, it is recognized that modifications and variations may readily occur to those skilled in the art, and consequently, it is intended that the claims be interpreted to cover such modifications and equivalents.

What is claimed is:

1. A freely rolling low friction toy vehicle comprising: a vehicular frame; axle means including end portions of small diameter flexible spring wire protruding from opposite sides of said frame;
- a one-piece radial bearing of a synthetic polymer material rotatably mounted on each of said end portions, each of said end portions having means for retaining its radial bearing thereon; and
- a wheel at each said end portion, each wheel having an inner side for receiving one of said radial bearings and an outer side defining a hub cap, each of said bearings including means trapping the retaining means of an associated one of said end portions between an associated one of said bearings and an associated one of said hub caps for substantial axial motion therebetween to minimize frictional contact with said retaining means while limiting axial displacement of said wheels on said end portions.
2. The toy vehicle described in claim 1 wherein: each of said hubcaps comprises an inwardly-directed thrust member.
3. The toy vehicle described in claim 2 wherein: said inwardly-directed thrust members each comprises a rounded protuberance and said retaining means each has a substantially flat outer face engageable by an associated one of said protuberances.
4. The toy vehicle described in claim 1 wherein: the outer surface of each of said bearings is slightly concave for forming ridges adapted to frictionally engage said wheel.
5. The toy vehicle described in claim 1 wherein: at least one end of each of said bearings is larger in diameter than the central portion thereof, each said end adapted to be received by said inner side of said wheel.
6. The toy vehicle described in claim 1 wherein: said spring wire is tinned, thereby providing a smooth running surface for said bearing.
7. The toy vehicle described in claim 1 wherein: said spring wire is made from approximately 20 thousandths diameter, 0.8% carbon content, extra-high strain, tinned mandolin wire.
8. The toy vehicle described in claim 1 wherein: each of said wheels includes a road-engaging first rim portion and a second rim portion of greater width and slightly smaller diameter than said first rim portion, whereby second said rim portion simulates a tire having a wide tread while said first rim portion provides low road friction.

9. The toy vehicle described in claim 8 wherein: said second rim portion is axially tapered between a large diameter section adjacent to said first rim portion and a smaller diameter section further from said first rim portion.
10. The toy vehicle described in claim 8 wherein: the maximum diameter of said second rim portion is at least 90% of the diameter of said first rim portion.
11. In a freely rolling low friction toy vehicle including a vehicular frame, the combination comprising:  
 axle means including end portions of small diameter flexible spring wire protruding from said frame;  
 a one-piece radial bearing of synthetic polymer material rotatably mounted on each said end portion, said each end portion having means for retaining said radial bearing thereon; and  
 a wheel at said each end portion of said axle means, said wheel having an inner side for receiving said radial bearing and an outer side defining a hub cap for said wheel, the portion of said wheel for contacting a rolling surface being tapered thereby reducing the amount of surface contact and rolling friction between said wheel and rolling surface, at least one end of said bearing having a diameter larger than the center portion thereof, each said end adapted to be received by said inner side of said wheel, and said hub cap concealing said retaining means.
12. In a toy vehicle including a vehicular frame and axle means including at least one end portion of small diameter flexible spring wire protruding from said frame, wheel means comprising:  
 a one-piece radial bearing of synthetic polymeric material rotatably mounted on said end portion, said end portion having means for retaining said radial bearing thereon;  
 a wheel member at said end portion, said wheel member having an inner side defining a hub cap for said wheel means, at least one end of said bearing being of a larger diameter than the central portion thereof of each said end adapted to engage said inner side of said wheel member; and

- thrust member means limiting axial displacement of said wheel means.
13. A wheel means as stated in claim 12 wherein: said thrust member means comprises an inwardly-directed protuberance carried by said hub cap, said protuberance being engageable with said retaining means.
14. A wheel means as stated in claim 13 wherein: said retaining means comprises an enlarged head having a substantially flat outer face engageable by said protuberance.
15. A wheel means as stated in claim 12 wherein: said wheel member includes a road-engaging first rim portion and a second rim portion of greater width and slightly smaller diameter than said first rim portion, whereby said second rim portion simulates a tire having a wide tread while said first rim portion provides low road friction.
16. A wheel means as stated in claim 15 wherein: said second rim portion is axially tapered between a large diameter section adjacent to said first rim portion and a smaller diameter section furthest from said first rim portion.
17. A wheel means as stated in claim 15 wherein: the maximum diameter of said second rim portion is at least 90% of the diameter of said first rim portion.

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U.S. Cl. X.R.

46—221; 301—68

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,483,654

December 16, 1969

Harvey W. La Branche et al.

It is certified that error appears in the above identified patent and that said Letters Patent are hereby corrected as shown below:

Column 7, line 4, "further" should read -- furthest --;  
line 39, after "inner side" insert -- for receiving said  
radial bearing and an outer side --.

Signed and sealed this 8th day of September 1970.

(SEAL)

Attest:

Edward M. Fletcher, Jr.

Attesting Officer

WILLIAM E. SCHUYLER, JR.

Commissioner of Patents