Aug. 12, 1952 K. FUCHS 2,606,402

AUTOMATICALLY STEERABLE TOY VEHICLE

Filed Dec. 2, 1948 2 SHEETS—SHEET 1

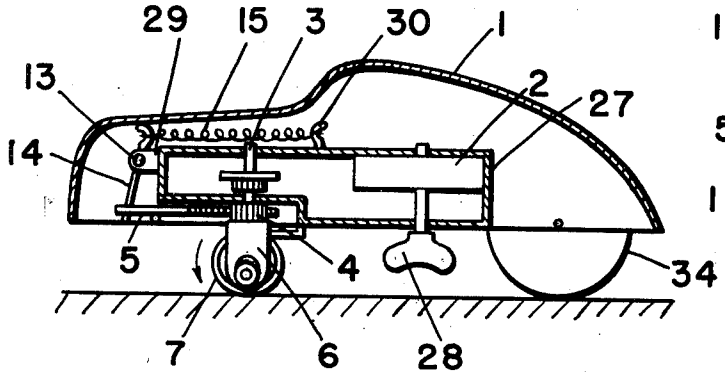


FIG.1

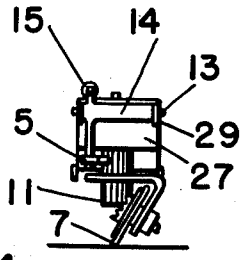


FIG.2

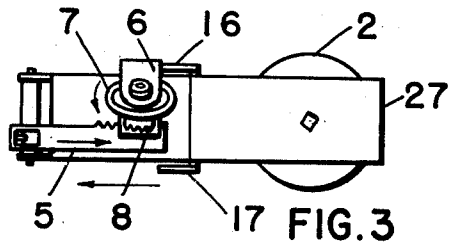


FIG.3

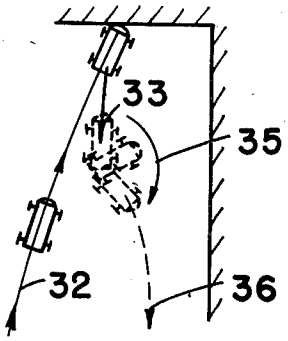


FIG.7

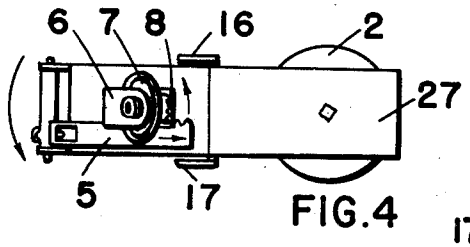


FIG.4

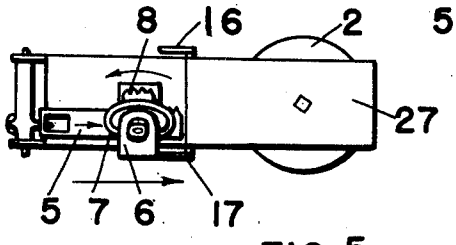


FIG.5

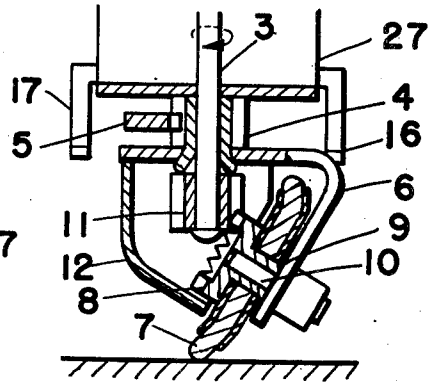


FIG.6

INVENTOR
KARL FUCHS
BY Maurice Block
ATTORNEY

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AUTOMATICALLY STEERABLE TOY VEHICLE

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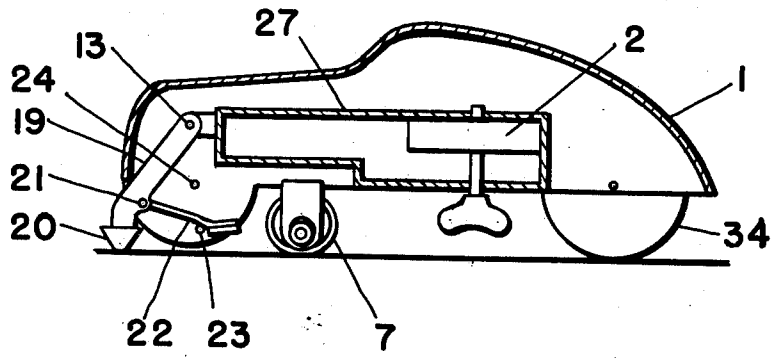


FIG. 8

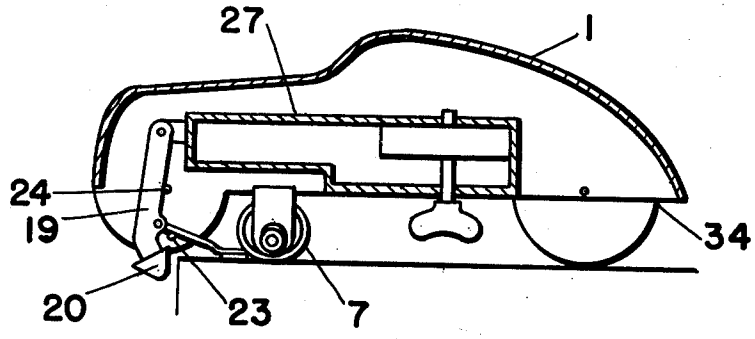


FIG. 9

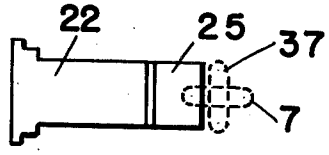


FIG. 10

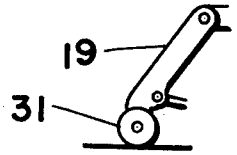


FIG. 12

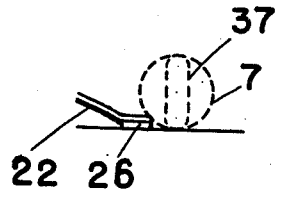


FIG. 11

INVENTOR
KARL FUCHS
BY Kramer Black
ATTORNEY

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UNITED STATES PATENT OFFICE

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AUTOMATICALLY STEERABLE TOY VEHICLE

Karl Fuchs, Nuremberg, Germany

Application December 2, 1948, Serial No. 62,987
In Germany October 1, 1948

3 Claims. (Cl. 46—211)

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My invention relates to automatically steerable toy vehicles which may simulate real vehicles, for example automobiles, or any other movable objects, for example animals like beetles or mice. More particularly, my invention relates to rolling toys which are driven and steered by means of a track-contacting wheel which is rotated about its axis by a motor-driven gear and which is turnable about a vertical axis whereby the same wheel can drive forwardly and backwardly.

In known vehicles of this type, the turning of this wheel and, thereby, the steering of the vehicle is effected by a shock absorber or projecting rod when the vehicle hits an obstacle. This rod is shiftable in the normal driving direction relatively to the vehicle's body and is connected by a rack with a pinion affixed to a swivel arm which is affixed to the bearing of the driving and steering wheel. A spring counteracts the backward shift of the shock absorber and presses the same back into normal position when the turning movement has been completed. The driving and steering wheel is connected to a vertical driving shaft by an angular gear.

Objects of my invention are to simplify the structure of an automatically steerable toy vehicle, to make unnecessary the arrangement of a shiftable shock absorber, and to effect the automatic steerage without such a shock absorber whenever the forward drive of the vehicle is obstructed.

Other objects are to provide a toy vehicle that not only steers away from an obstacle hit by the vehicle but also from an edge of the track before the vehicle drops over this edge, to provide a toy vehicle that in each of these cases makes an evasive movement, to provide means causing an evasive movement comprising a short backward drive and a turning movement, and to provide a toy vehicle that, after an evasive movement, automatically starts again forwardly in a direction different from the vehicle's original direction.

My invention makes use of the known driving and steering wheel driven by a motor over a vertical shaft and an angular gear and rotatable in a bearing which is turnable about this shaft by means of a swivel arm. During unobstructed forward drive, a spring, a weight or the like presses the structure comprising this wheel against a stop.

According to my invention, this spring, weight or other urging means as well as the angular gear and the driving and steering wheel are so measured that the torque exerted by the urging means on the swivel arm is smaller than the oppositely directed torque which results, when the vehicle stops suddenly, from the torque exerted on the same arm by the driving force plus the torque exerted on this arm by bearing friction minus the torque of the wheel's frictional resistance on the track.

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A more complete explanation of the nature of my invention and still other objects and advantages will appear from the following description of exemplifying embodiments of my invention, from the appended claims and from the accompanying drawing in which:

Figure 1 shows a partly sectional side view of an illustrative embodiment of my invention.

Fig. 2 shows a front view of the swivel device used in this embodiment.

Figs. 3 to 5 show bottom views of parts of the same embodiment, each of these figures showing the steering wheel in a different position.

Fig. 6 shows a vertical cross-section of the steering wheel and of connected parts of the same embodiment.

Fig. 7 shows a top view of a surface or track on which the vehicle is indicated in several phases of movement.

Figs. 8 and 9 show partly sectional side views of an embodiment comprising an automatic stop device responsive to the approach to an edge of the track, some parts of this embodiment being omitted.

Fig. 10 shows a bottom view and Fig. 11 a side view of a part of this stop device, positions of the driving and steering wheel being schematically indicated.

Fig. 12 shows a side view of a modified part of this stop device.

Referring to the drawings, numeral 1 indicates a shell or case of a car. A clock work or spring motor 2 positioned in the case 1 is coupled with a vertical shaft 3 in any well known, not shown manner and can be wound up by a handle 28. The motor may be inserted in a frame 27. This frame and the case 1 are parts of the vehicle's body structure.

A pinion 4 is arranged rotatably about the shaft 3 as best seen in Fig. 6. The pinion 4 engages a rack 5 and is affixed to a swivel arm 6. The driving and steering wheel 7 may be provided in well known manner with a rubber rim cover and is rotatably connected to the arm 6 in the following manner: A bushing 9 is centrally affixed to the wheel 7 and surrounds rotatably a shaft 10 affixed to the arm 6. One end of the bushing 9 forms a crown-shaped toothed wheel 8 which engages a pinion 11 affixed to the shaft 3. The arm 6 is so bent that the wheel 7 has an oblique position and contacts the track at a point which lies in the extension of the axis of the shaft 3.

A lever 14 is pivoted at 13 to an extension 29 of the frame 27 and has one end engaging an end of the rack 5. The other end of the lever 14 is hooked to a spring 15 (see Figs. 1 and 2). The other end of this spring is affixed to the frame 27 at 30.

Two stop members are affixed to the frame 27. The arm 6 leans against one of these members when the vehicle moves substantially straight

ahead, and leans against the other member when the vehicle moves straight backwardly (see Figs. 3 and 5). For example, the stop member 16 may be so arranged that the swivel arm contacts this member when the wheel 7 is positioned for forward drive. The member 16 may be so arranged that the vehicle, when driving forwardly, does not run exactly straight ahead but runs in a circle of large radius, the center of which is situated at the side of the evasive movement which will be described later. The angular gear constituted by the toothed wheel 8 and the pinion 11 is protected by a cover 12 against dirt (Fig. 6).

The spring 15 exerts a torque urging the arm 6 toward the stop 16. Another torque urging the arm 6 in a direction opposite to the urge of the spring results from the driving force transmitted from the pinion 11 to the toothed wheel 8 and reacting on this pinion. The latter torque has a definite maximum when the wheel 7 is arrested, is increased by the torque resulting from the friction between the arm 6 and the shaft 3 and is only slightly reduced by a torque resulting from the frictional resistance between the wheel 7 and the surface area or track on which the vehicle moves. The spring 15 is so measured that the torque resulting from this spring is smaller than the torque resulting from the driving force and the mentioned frictions when the wheel 7 is arrested. This condition defines the relationship between the measures of the spring, of the motor and of the structural parts involved, and can be easily fulfilled, for example, by simply selecting or adjusting the spring 15 according to the defined condition.

According to Figs. 8 and 9, an arm 19 is hinged to the vehicle near the front end of the latter. A feeler body 20 is affixed to the free end of the arm 19. A lamina 22 is pivoted to the arm 19 at a point 21 positioned over the body 20. When the movement of the vehicle is unobstructed, the free end of the lamina 22 rests on a support 23 affixed to the case 1.

The combined length of the arm 19 and the feeler body 20 is larger than the distance of the turning point 13 from the track. A stop 24 for the arm 19 is affixed to the case 1. The lamina 22 is provided with a rubber layer 26 covering the lower side of the lamina's free end 25 (see Figs. 10 and 11). Instead of the feeler body 20, a little wheel 31 may serve as a feeler. This wheel may be rotatably connected with the arm 19 (Fig. 12).

The tov operates as follows:

The driving force is transmitted from the pinion 11 to the toothed crown 8 of the wheel 7 in a direction that is at least partly horizontally directed and that has a lateral distance from the shaft 3 or from the turning axis of the swivel arm 6. Hence this force, in addition to its rotating effect on the wheel 7, has a tendency to turn the wheel 7 and the arm 6 about the shaft 3. When the vehicle moves ahead unobstructedly, this driving force serves mainly for the rotation of the wheel 7 about its axis. During this unobstructed movement, the swivel arm 6 is pressed against the stop member 16 by the spring 15 against the torques exerted by the tooth force of the angular gear and by the friction of the swivel arm bearing. The member 16 is so set that, in this case, the wheel 7 drives the vehicle in a circle 32 of large radius (see Figs. 3 and 7). When the vehicle hits an obstacle or is suddenly arrested, the full driving power is available for turning the driving and steering wheel 7, except for a reduction of this power by the frictional track resistance of the wheel 7. In addition, the friction of the swivel bearing is considerably increased at this moment by a momentum of capsizing forces. The driving power drives the wheel 7 together with the swivel arm 6 abruptly about the shaft 3 in an arc of maximally 180 degrees whereupon the swivel arm contacts the stop member 17. (Figs. 4 and 5.) During this turning movement, the frictional track resistance is considerably reduced because the wheel 7 is so obliquely positioned that the point of its contact with the track lies in the turning axis.

After this turning movement has been completed, the rotating direction of the wheel 7 with respect to the vehicle is reversed and the motor drives the wheel so that the vehicle is driven backwardly. (See arrow 33 in Fig. 7.)

Shortly after this reversal, the forces causing the turning torques resume their original strengths whereby the torque exerted by the spring 15 prevails again. Hence the spring turns the wheel 7 out of its backwardly driving position. This latter turns is not as abrupt as the first mentioned turn of the wheel 7, due to the retarding effect of the vehicle's kinetic energy. While the wheel 7 returns from the backwardly driving position to the ahead driving position, it assumes intermediate positions and, being permanently rotated, drives the vehicle so that the vehicle turns more or less about its rear wheels 34 (see arrow 35 in Fig. 7). Finally, the swivel arm again contacts the stop 16 whereupon the vehicle is again set for normal forward drive, for example, in the direction of the arrow 36 which direction is different from the vehicle's original direction.

From the foregoing appears that the vehicle makes an evasive move composed of two movements, a short backward movement and a turning movement.

When the vehicle approaches the edge of the track, or of a table used as a track, so far that the feeler body 20 projects beyond this edge, this body drops from its ordinary position in which the body slides on the track surface. (See Fig. 9.) Thereby the arm 19 turns about the hinge 13. The lamina 22 slides away from its support 23 into contact with the wheel 7. The rotation of this wheel draws the lamina under the wheel until the arm 17 contacts the stop 24.

In this position, the lamina 22 stops the forward motion of the wheel 7 on the track and, hence, the ahead motion of the vehicle. This stoppage causes a similar evasive move as the stoppage by an obstacle hit by the vehicle. As in this latter case, the evasive move comprises a rear drive and a turn, and ends in setting the vehicle for forward drive in a direction different from the original direction. During the evasive movement, the feeler body 20 having dropped beyond the table edge (Fig. 9) is lifted by this edge. Thereby, the lamina 22 is simultaneously withdrawn and repositioned on the support 23 (see Fig. 8). When the vehicle turns, the lamina's sliding rear end 25 assumes a position slightly in front of the vertical shaft 3 or in front of the lowermost point of the wheel 7. Hence, when the wheel is in the crossing position indicated at 37 in Figs. 10 and 11, this wheel rests again on the track and causes the front part of the vehicle to carry out a short cross movement until the feeler body has been withdrawn over the table edge.

The rubber layer 26 on the lower side of the

free end **25** of the lamina **22** increases the friction when the lamina contacts the track and thereby secures an immediate braking of the vehicle.

In addition to the advantage that the toy is simpler and consequently less expensive than known toys of this type because the invention makes the use of a movable shock absorber or projecting rod unnecessary, my toy vehicle can be used in a larger variety of shapes, for example in the shape of a mouse or of a beetle, without showing parts that impair the natural appearance of this shape. My toy vehicle turns away not only when hitting a fixed obstacle but also when stopped by hand.

If the toy is provided with a feeler body in the manner described, it may be operated not only, for example, on the floor of a room but also on a table without falling from the table when reaching an edge thereof. Additional obstacles may be erected on the table, and the vehicle will evade the same automatically. These possibilities enlarge and enrich the range of possible applications considerably and increase the interesting value of the toy.

I desire it understood that my invention is not confined to the particular embodiments shown and described, the same being merely illustrative, and that my invention may be carried out in other ways without departing from the spirit of my invention as it is obvious that the particular embodiments shown and described are only a few of the many that may be employed to attain the objects of my invention.

Having described the nature of my invention, what I claim and desire to protect by Letters Patent is:

1. An automatically steerable vehicle movable on a raised surface area and comprising a body structure, a motor carried by said structure, a vertical shaft rotated by said motor, a swivel arm turnable about said shaft, a driving and steering wheel connected to said swivel arm, rotatable about its axis and turnable together with said arm about said shaft, a gear driven by said shaft and transmitting driving force to said wheel in the direction of a horizontal line having a lateral distance from said shaft whereby said gear tends to rotate said wheel and, in addition, exerts a torque tending to turn said wheel and said arm about said shaft, a stop affixed to said structure and so positioned that said arm approaches said stop when turning in a direction opposite to said torque and that said arm is stopped by said stop in a position where said wheel is positioned for forward drive, means exerting a torque urging said arm toward said stop and being so measured that, when the vehicle is arrested, said latter torque is smaller than said torque of the force-transmitting gear, increased by the torque of said arm's and shaft's turning friction and reduced by the torque of said wheel's frictional resistance on said surface area, and means responsive to the vehicle's approach to a downward sloping edge of said surface area and obstructing the progress of said driving and steering wheel.

2. An automatically steerable vehicle movable on a raised surface area and comprising a body structure, a motor carried by said structure, a vertical shaft rotated by said motor, a swivel arm turnable about said shaft, a driving and steering wheel connected to said swivel arm, rotatable about its axis and turnable together with said arm about said shaft, a gear driven by said shaft and transmitting driving force to said wheel in the direction of a horizontal line having a lateral distance from said shaft whereby said gear tends to rotate said wheel and, in addition, exerts a torque tending to turn said wheel and said arm about said shaft, a stop affixed to said structure and so positioned that said arm approaches said stop when turning in a direction opposite to said torque and that said arm is stopped by said stop in a position where said wheel is positioned for forward drive, means exerting a torque urging said arm toward said stop and being so measured that, when the vehicle is arrested, said latter torque is smaller than said torque of the force-transmitting gear, increased by the torque of said arm's and shaft's turning friction and reduced by the torque of said wheel's frictional resistance on said surface area, an arm pivoted to said structure, a feeler body attached to the end of said latter arm and having a weight causing said body to drop into sliding contact with said surface area, and a lamina pivoted to said latter arm at a point over said body and positioned in front of said wheel, said lamina and said latter arm being so arranged that said lamina is shifted into contact with said wheel when said body drops beyond an edge of said surface area.

3. An automatically steerable vehicle movable on a raised surface area and comprising a body structure, a motor carried by said structure, a vertical shaft rotated by said motor, a swivel arm turnable about said shaft, a driving and steering wheel connected to said swivel arm, rotatable about its axis and turnable together with said arm about said shaft, a gear driven by said shaft and transmitting driving force to said wheel in the direction of a horizontal line having a lateral distance from said shaft whereby said gear tends to rotate said wheel and, in addition, exerts a torque tending to turn said wheel and said arm about said shaft, a stop affixed to said structure and so positioned that said arm approaches said stop when turning in a direction opposite to said torque and that said arm is stopped by said stop in a position where said wheel is positioned for forward drive, means exerting a torque urging said arm toward said stop and being so measured that, when the vehicle is arrested, said latter torque is smaller than said torque of the force-transmitting gear, increased by the torque of said arm's and shaft's turning friction and reduced by the torque of said wheel's frictional resistance on said surface area, an arm pivoted to said structure, a feeler body attached to the end of said latter arm and having a weight causing said body to drop into sliding contact with said surface area, and a lamina pivoted to said latter arm at a point over said body and positioned in front of said wheel, said lamina and said latter arm being so arranged that said lamina is shifted into contact with said wheel when said body drops beyond an edge of said surface area, said lamina having a rubber layer covering the lower side of that portion of said lamina which is nearest to said wheel.

KARL FUCHS.

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