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(54) Title: WHEELED TILTING APPARATUS



This invention relates to tilting apparatus for wheels and more particularly to apparatus for causing wheels of a relatively lightweight vehicle to tilt as the vehicle travels over a curve in a road.

The wheels of a two-wheeled vehicle such as a motorcycle or a scooter tilt as the vehicle is driven on a curve in a road if the driver of the vehicle shifts his weight into the curve. In fact, part of the enjoyment which the driver experiences from such a vehicle is the way the vehicle tilts as he shifts his weight into the curves of a winding road.

Vehicles having more than two wheels do not tilt in the same way. For example, a three-wheeled vehicle such as a motorcycle with a side-mounted wheeled-compartment for a passenger does not tilt as the vehicle rounds a curve unless the vehicle is travelling at an excessive speed. When the vehicle travels at such speed and it rounds a curve on the opposite side of the vehicle as the passenger compartment, the wheels of the motor cycle tilt but as they do, the wheel of the passenger compartment lifts off the road. The vehicle then becomes unstable and difficult if not impossible to control.

Vehicles having four or more wheels generally do not respond to the shifting of a driver's weight because they are too heavy. If however the vehicle is light enough to respond, the vehicle too become unstable in the same way as a three-wheeled vehicle.

I have invented an apparatus which has two tilting wheels and which, when attached to a two-wheeled vehicle such as a motorcycle or a scooter, allows the wheels of the vehicle to con-

tinue to tilt. For example, the swing arm or rear fork of a motorcycle can be removed and my apparatus can be bolted to the existing swing arm mounting points. My apparatus accordingly converts a two-wheeled vehicle into a four-wheeled vehicle in which all four wheels tilt as the vehicle rounds a curve. A motorcycle or a scooter to which the apparatus is attached becomes more stable and hence easier to control since it does not tip over when it is stationary. My apparatus does not, however, detract from the enjoyment which a driver derives from the tilting of the vehicle as it rounds curves.

My apparatus can alternatively be substituted for one of the wheels of a two-wheeled vehicle. The forward or rear wheel of a motorcycle or scooter can be removed and replaced by my apparatus so that the motorcycle or scooter has an additional third wheel.

Briefly, the apparatus of my invention includes: a frame; a pair of wheel supports; and a pair of axially aligned wheels each rotatable about a separate wheel support. The apparatus also includes two pairs of lower and upper parallel links, each pair of the links being pivotal about lower and upper pivot points, respectively, on a separate wheel support. Each pair of the links are pivotal about the frame;. A rocker is pivotal relative to the frame; and a pair of transverse arms are each pivotal about a lower pivot point on a separate wheel support and an upper pivot point on the rocker. The frame, while travelling on the curve, tilting toward the direction of the curve with like tilting of the wheels.

The apparatus of the invention is described with reference to the accompanying drawings

which all show views of the apparatus from the rear. In the drawings:

Figure 1 is an elevation of the apparatus as it would appear when a vehicle to which it is attached is travelling straight forward or straight backward;

Figure 1A is an elevation of a variation of the apparatus illustrated in Figure 1;

Figure 2 is an elevation of the apparatus as it would appear when the vehicle is turning to the left;

Figure 3 is an elevation of the apparatus as it would appear when the vehicle is turning to the right; and

Figure 4 is an elevation of the apparatus as it would appear when the vehicle was travelling over a bump in the road.

Like reference characters refer to like parts throughout the description of the drawings.

With reference to Figure 1, the apparatus of the invention, identified generally by the numeral 10, includes a central rectangular frame 12 and a pair of axially aligned wheels 14, 16 on opposite sides of the frame. Each wheel is rotatably mounted to a separate wheel support 18, 20.

Wheel support 18 is connected to the frame by a pair of links 24, 26. The links are parallel to one another and are spaced apart vertically. The lower link 24 is pivotally attached at pivot point 30 to the wheel support and is pivotally attached at pivot point 32 to the frame while the upper link 26 is pivotally attached to the wheel support and frame at points 34 and 36 respectively. Similarly, wheel support 20 is attached to the opposite side of the frame by lower

and upper parallel links 38, 40. The latter links are also pivotal about both the wheel support 20 and the frame.

A triangular-shaped rocker 40 is pivotally connected at its lower angle or vertex 42 to the frame. The point of connection or first pivot point 42 is spaced equidistantly from the longitudinal axes 44-44 of the wheels. Thus the distance between the first pivot point and the longitudinal axis of wheel 14, marked 45L, is the same as the distance between the first pivot point and the longitudinal axis of wheel 16, marked 45R.

The upper ends of two transverse arms 46, 48 are pivotally attached to second and third upper pivot points 50, 52, respectively, of the rocker. Transverse arm 46 extends downwardly and outwardly toward wheel 14 and is pivotally connected to wheel support 18 at lower pivot point 30 while transverse arm 48 similarly extends downwardly and outwardly toward wheel 16 and is connected to wheel support 20 at lower pivot point 54.

The point of connection of the upper end of transverse arm 46 to the rocker is higher than the point of connection of its lower end to the wheel support. In other words, upper pivot point 50 is at a higher elevation than lower pivot point 30. Similarly, the point of connection of the other transverse arm 48 to the rocker is higher than the point of connection of its lower end or pivot point 54 to wheel support 20.

Transverse arm 46 is extendible from a retracted position to an extended position and is biased into the extended position by a coil spring 60 wound around the outer wall of the trans-

erse arm. Transverse arm 48 is of the same construction. Preferably the two transverse arms are conventional shock absorbers. Alternatively, the transverse arms may be composed of two tubes, one within the other and slidable with respect to the other. One of those tubes is connected to the rocker while the other tube is connected to the wheel support and the two tubes are biased apart by resilient means such as a coil spring within the two tubes.

The rocker is provided with a rod 62 which extends between the two upward sides of the rocker. The rod and passes through a curved tube 64 attached to the frame. A thumb screw 66 is threadably received in a wall of the tube and when tightened, engages the rod and immobilizes it. The thumb screw accordingly acts as a brake for selectively preventing the rocker from pivoting.

With reference to Figure 1A, the apparatus is the same as that illustrated in Figure 1 except for the shape of the rocker and the way in which its movement is restricted. Rocker 68 in Figure 1A is straight and is pivotally connected to transverse arms 70, 72 at only one point 74 adjacent to its upper end. Thus the upper ends of the two transverse arms pivot about a common point and not two points which are separated from one another as in the apparatus of Figure 1.

The lower end of rocker 68 is pivotally connected to frame 76 at point 80. A curved rod 82, similar to rod 62 in Figure 1 is attached to the frame and passes through a curved tube 84 on the rocker. A thumb screw 86 prevents the rocker from pivoting relative to the frame when the thumbscrew is tightened.

As indicated previously, the vehicle to which the apparatus of the invention is attached is

relatively light weight such as a motor cycle or scooter and it tilts as the driver of the vehicle shifts his weight.

The operation of the apparatus is as follows: with reference to Figure 2, the vehicle is travelling on a curve to the left and the driver, as he leans into the curve, shifts his weight to the left. As he does so, the left side of the vehicle tilts downward and the right side of the vehicle rises. As the vehicle tilts in this way, so too does frame 12. As the frame tilts, links 24, 26 will cause the left wheel 14 to tilt to the left and links 38, 40 cause the right wheel to tilt in the same direction.

The apparatus of the invention accordingly causes both wheels to tilt in the direction of the curve thereby increasing the speed at which a driver can negotiate the curve without loss of control. The driver can adjust the degree to which the two wheels tilt. In the apparatus of Figure 1, he can reduce the tilting of the wheels to zero by tightening thumbscrew 66 and by loosening the thumbscrew he can cause the wheels to tilt as much as the vehicle itself. does In the apparatus of Figure 1A, thumbscrew 86 serves the same purpose.

Figure 3 illustrates my apparatus as the vehicle travels on a curve to the right. The operation of the apparatus is opposite to that described with reference to Figure 2.

In Figure 4, the right wheel 16 travels over a bump 70 in the road. The bump causes the wheel to rise and the right transverse arm 48 to apply a counterclockwise moment on the rocker. However the rocker does not pivot because the counter clockwise moment is resisted by the bias

of coil spring 60 on the left transverse arm 46. The force which the bump applies on the right wheel causes the right transverse arm 48 to retract or shorten and both left and right wheels remain upright.

It will be understood, of course, that modifications can be made in the structure of the apparatus of my invention without departing from the scope of the invention as defined in the appended claims. For example, power can be supplied to one or both of the wheels to drive them. An electric motor powered by a battery would be suitable for this purpose.

I claim:

1. Wheel-tilting apparatus for a relatively light-weight vehicle, said apparatus including: a frame; a pair of wheel supports; a pair of axially aligned wheels each rotatable about a separate said wheel support, two pairs of lower and upper parallel links, each pair of said links being pivotal about lower and upper pivot points, respectively, on a separate said wheel support and each pair of said links being pivotal about said frame; a rocker pivotal relative to said frame; a pair of transverse arms each pivotal about a lower pivot point on a separate said wheel support and an upper pivot point on said rocker, said frame, while travelling on said curve, tilting toward the direction of said curve with like tilting of said wheels.
2. Wheel-tilting apparatus for a relatively light-weight vehicle, said apparatus including: a frame; a pair of wheel supports; a pair of axially aligned wheels each rotatable about a separate said wheel support, two pairs of lower and upper parallel links, each pair of said links being pivotal about lower and upper pivot points, respectively, on a separate said wheel support and each pair of said links being pivotal about said frame; a rocker pivotal relative to said frame; a pair of transverse arms each pivotal about a lower pivot point on a separate said wheel support and an upper pivot point on said rocker, said upper pivot point of one said transverse arm being spaced apart from said upper pivot point of the other said transverse arm, said frame, while travelling on said curve, tilting toward the direction of said curve with like tilting of said wheels.

3. The wheel-tilting apparatus of claims 1 or 2 wherein said upper pivot point is at a higher elevation than that of the lower pivot point of each said transverse arm.
4. The apparatus of claims 1, 2 or 3 wherein said transverse arm is extendible from a retracted position to an extended position, said apparatus further including resilient means for biasing said transverse arm into said extended position.
5. The apparatus of claim 4 wherein said transverse arm is a shock absorber.
6. The apparatus of claims 1, 2 or 3 further including means for selectively preventing said rocker from pivoting.

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Figures: Fig. 1, 1A, 2, 3, 4

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