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DESIGN and ANALYSIS of ACTIVE LEANING SUSPENSION

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Abstract—A preferably four wheeled vehicle having tilting characteristics that allows the vehicle to have substantial leaning properties similar to those offered by an inline two wheel vehicle, but that does not require complex linkages or control system to operate effective. We are designing this mechanism in order to increase the cornering safety and stability of the vehicle at high speeds as according to the local survey done riders face difficulty in cornering and controlling the vehicle at high speeds. We are using four linkage mechanism for allowing the vehicle to tilt or lean. These four linkage through two uprights at front and rear while is drive is only given to rear wheels.

Keywords—V Tilting, Leaning, Linkages, Cornering, Safety, Stability, Suspension

I. INTRODUCTION

A four wheeled vehicle, with two steerable front wheels and a driven rear wheels which are motor powered, includes steering/coupling linkage disposed adjacent to the lower end of a steering column having a handle bar attached to its upper end connected through four linkages. This mechanism consists of two control arms and ball joints including in the unsprung mass of the vehicle. We have a mono shock suspension at the front to enhance tilting of the vehicle which is attached to the lower control arm by a link. At the rear we have bell crank actuated mono shock suspension which is offset to the lower control arm in order to incorporate axles to drive the wheels.

II. NEED OF PROJECT

The present arrangement overcomes the cornering problems of vehicle by counteracting the centrifugal force exerted upon a vehicle and its rider during a turn at high speeds. In the present invention the seat moving inward in relation to the amount of turn shifts the center of gravity of the rider inward from a line between where the rear wheel and the outer front wheel contact the road so that the rider's weight has a greater anti-rotational force about the aforementioned line to permit a greater centrifugal force on the rider without the vehicle tipping over or the rider falling outward. Also, in the present invention centrifugal force acting on the rider moves him outward, causing the rear frame to rotate and the front wheels to swing back so as to lessen the sharpness of the turn and prevent the vehicle from rolling over.

III. LITERATURE SURVEY

1. Edward M. Smith, Robert E. Mclver introduced a patented paper on leaning vehicle suspension where they designed linkages for leaning suspension which can be fitted in a four wheeled bike. In order to improve the cornering ability and to reduce the susceptibility of bikes to road accidents. A vehicle including a frame, left and right wheels, and a leaning suspension system. The frame defines a longitudinal vehicle axis. The leaning suspension system includes a transverse beam, left and right damping members, left and right control arms, and at least one lean actuator. The transverse beam is coupled to the frame and pivotable about the vehicle axis. The left and right damping members are pivotally coupled to the left and right sides of the transverse beam. The left control arm is pivotally

coupled to the left wheel and to the frame, and the right control arm is pivotally coupled to the right wheel and to the frame. The lean actuator is pivotally connected between the frame and the transverse beam. The lean actuator is configured to extend and retract to tilt the left and right wheels and to lean the vehicle while cornering.

2. Leaning vehicle suspension by Steven W. LUCAS designed the suspension for leaning. The suspension includes a planar central upright frame which is mounted coaxially to the main frame of the tricycle. Upper and lower control arms are hinged to the central upright frame and extend to the left and to the right to connect to wheel bearing housings. An inverted rocker assembly is hinged to the central frame, pivotable about the front and rear ends of the central frame at points located in the upper third of the distance between the top and bottom of the central frame. The inverted rocker assembly provides connection points for shock absorbers which interconnect the inverted rocker assembly with each link member of the lower control arm on each side of the central frame.

3. Another petition filed by Daniel Mercier on control systems for leaning suspension studies in detail the concept of counter steering. The driver thus applies a torque to the handlebar in the direction opposite the intended direction of the turn. Attempting to turn the handlebar to the right, for example, initially turns the front wheel to the right, which causes the vehicle to initially turn gently to the right. This gentle turn to the right generates a roll moment on the vehicle to the left. The roll moment causes the motorcycle to lean to the left, which can be augmented by the driver leaning to the left, and as a result the vehicle executes a left turn. Free-leaning three-wheeled vehicles may allow the driver to countersteer, but they generally have to overcome more resistance than two-wheeled vehicles when leaning. A motorcycle can be leaned merely by overcoming the gyroscopic effect of the wheels and tilting the vehicle to one side, whereas a three-wheeled vehicle must typically overcome a greater gyroscopic effect due to the three wheels, as may also have to pivot its frame relative to the suspension systems of the two laterally-spaced wheels. As a result, free-leaning three-wheeled vehicles may have a higher resistance to leaning, and as a result may be more difficult or less enjoyable to drive than motorcycles.

4. Daniel Mercier published another paper on leaning vehicle with tilting front wheels and suspension therefor. A leaning vehicle has a frame pivotally connected to the lower end of a shock tower, the pivotal connection defining a frame leaning axis wherein the frame is adapted to lean to a right side and to a left side relative to the shock tower about the frame leaning axis. The leaning vehicle includes an actuator operatively connected to the frame and to the shock tower which is adapted to impart a leaning motion to the frame relative to the shock tower about the frame leaning axis. In addition to having the frame lean into a corner while turning a leaning vehicle, the two front or rear wheels of the leaning vehicle may also tilt in the same direction as the frame to reflect the general behavior of a motorcycle. In order to allow the two front or rear wheels to lean to one side or the other, the suspension assembly must be connected to the wheels in such a manner that the suspension components do not interfere with the leaning wheels. An improvement of the vehicle disclosed in U.S. Pat. No. 6,328,125 in which the two rear wheels can lean into a corner is disclosed in U.S. Pat. No. 6,863,288 also to Van Den Brink et al.

IV. PROJECT SPECIFICATION

A right front steerable wheel and a left front steerable wheel disposed on respective sides of a central steering shaft having a handlebar attached thereto wherein each of said right and left front steerable wheels has a respective turning pivot. The rear wheels are given drive by a open differential with reversing mechanism. A rear frame supporting a rider, said rear wheel, and a vehicle propulsion arrangement. The characteristics of wheels are selected for optimum results considering leaning suspension as it simulated in LOTUS and SUSPROG simulation software. The Quad is powered by 222cc with maximum power of 20BHP and torque of 19.7Nm at 6500rpm.

V. CONCLUSION

Current feasibility study indicates that the tilting action is highly sensitive to weight distribution. It will be important and challenging to design the vehicle such that all components coordinate to produce the desired tilting effect.

This mechanism is able to negate the forces coming on the vehicle at high speeds.

Complexity in packaging suspension devices & powertrain devices with leaning properties.

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