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ADVANCED QUAD WHEEL SUSPENSION VEHICLE

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ABSTRACT

This vehicle works on the principle of lean suspension in which all four wheels are having independent suspension (lean suspension) by which we can increase stability, safety of vehicle. This project is mainly focused on an idea about lean suspension to increase the cornering safety and stability of the vehicle at high speeds as according to the local survey done the bike riders face difficulty in cornering and controlling the vehicle at high speeds. We are using control arms (four linkage mechanism) for allowing the vehicle to tilt or lean. It can provide many performance and design advantages including greater stability while turning and reduced probability of rollover while taking a turn. The controlling of this vehicle is easy as compared to other two or three wheelers. It is capable to withstand bumps and shocks.

Keywords— Lean Suspensions, Stability, Automobile Suspension, Double Suspension System

I INTRODUCTION

Independent suspension is a broad term for any automobile suspension system that allows each wheel on the same axle to move vertically (i.e. reacting to a bump in the road) independently of the others. This project vehicle has fully independent suspension that means it includes independent front suspension (IFS) and independent rear suspension (IRS) both. IRS has the rear wheels independently sprung. A fully independent suspension has an independent suspension on all wheels. Road vehicles can expend a significant amount of energy in undesirable vertical motions that are induced by road bumps, and much of that is dissipated in conventional shock absorbers as they dampen the vertical motions. A conventional automotive shock absorber dampens suspension movement to produce a controlled action that keeps the tire firmly on the road. This is done by converting the kinetic energy into heat energy, which is then absorbed by the shock's oil. The steering / coupling linkage includes a pivot shaft, a bearing housing and a mechanical connection for leaning the rear frame in the direction of a turn to compensate for centrifugal force encountered in turning the vehicle. The mechanical connection causes the rear frame to lean in a controlled relationship to the amount of rotation of the steering shaft, within rotational limits, to emulate the leaning action of a conventional bike when making a turn.

II AIM OF THE PROJECT

- The main objective of this vehicle is used for leaning purposes.
- The goal of our project is to create a functioning double suspension system.
- To make bikes more comfortable for handicapped people.
- It can provide anti skidding effect and bikes can be used for on roads as well as off road purpose.

III LITERATURE REVIEW

3.1 Leaning suspension mechanics

On 22nd SEP 2009, Ryan J. Suhre and co. worked with Harley Davidson Motor Company and filed a patent. They had implemented their design on front wheel. The limitations of Lawayne were overcome. But the Ryan and co. had used hydraulic actuators to force the bike into leaning position while turning and back to upright position while tracking a straight line. The make a trike vehicle, which includes a frame, a rear drive wheel; conventional gasoline fuelled internal combustion engine, and two front wheels with a leaning suspension system. The suspension system includes one or more lean actuators configured to extend and retract to force-tilt the front wheels and to lean the motorcycle, responsive to a driver's pivotal rotation of the steering mechanism, e.g. the handle bars, through a corner. In trike's leaning suspension control system a force is applying to push the vehicle's centre of gravity in the direction of the turn, thus leaning the vehicle into a turn, here in after referred to as forced-leaning [2].

3.2 Leaning Vehicle with tilting front wheels

On 19th JAN 2010, Daniel Mercier implemented the leaning mechanism on vehicle. According to his design, 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 [3]. 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. He makes a leaning vehicle comprising an electronic control unit ECU.

3.3Toyota I road

On 19th July 2012, Robert B. Hill; Fred Lux, Aloha; Timothy Michael Miller; Edmund Jerome Stilwell got a patent. In contrast to their patent, the free-to-lean design described herein enables the vehicle to lean smoothly and naturally, like a motorcycle, always on the correct lean angle, using no energy, and it then gently holds the vehicle upright at stops and low speeds, using almost no energy [4]. (Generally, when the vehicle is driven to a stop, the vehicle is already upright, such that the system only uses energy to close a hydraulic valve and hold the vehicle in the existing position (or applies very little pressure to adjust the lean angle a few degrees).

3.4 Tilting independent suspension system for motorcycle trike

The concept of tilting suspension came into existence during the 21st century. On 18th Mar 2008, Lawayne Matthias implemented it in three wheeled vehicles and also filed a patent. He had used active tilting. He had implemented his mechanism on rear wheel. We got our basic design about the leaning mechanism from his patent [1]. Generally, vehicles are rear wheel drive so according to Davis steering mechanism they must implement differential on rear wheel so that outer wheel travel with higher speed than the inner wheel. By

implementing it the design become very complex and the control system on frame can be complex. The main drawback of their design is to implement the mechanism on rear wheel.

IV METHODOLOGY

Our main aim is to design leaning mechanism which can sustain different type of loading during operation.

i. Calculation of dimensions: we calculate all the dimensions of different parts/ links based on the strength criteria. It is assumed that all parts are made from rigid material. The link joints and dampers have single degree of freedom. The cross section and area of each link is selected in such a way so they can withstand failure.

ii. Design and Analysis: After all the calculation we make 3D model of leaning mechanism in *SOLID WORKS* to analyse the stresses based on our calculated dimensions. For this analysis first we import 3D model of mechanism in *ANSYS.* Analysis confirms that all induced stresses are with the designed limit and strain is limited. *i.e.* There will no failure occur in the assembly.

iii. Fabrication: After confirming that the design is safe we will go for actual working model of leaning mechanism.

V CONSTRUCTIONAL FEATURES

5.1. Front Swing

Front swing consists of round pipe square pipe, MS plate, end bearing, hinges and bearing with bearing hub. The function of front swing used to give the flexibility in vertical as well as horizontal direction the hinges and end plane bearing very important role in swing [5].

5.2. Rear Swing

Rear swing consists of round pipe square pipe, MS plate, plane bearing, hinges and bearing with bearing hub. The function of Rear swing used to give the flexibility in vertical direction the hinges and end plane bearing very important role in swing [5].

5.3. Power Transmission System

Power from engine is transmitted to the both rear wheel of the vehicle with help of chain and sprocket mechanism, differential, universal coupling, bearing with bearing hub. Power from engine is transmitted through engine shaft to the sprocket mechanism which is connected to differential with the help of chain. The sprocket mechanism connected to the universal coupling due to this direction of power transmission is change. Finally power is transmitted from the engine shaft to both the rear wheels.

VI DESIGN DISCRIPTION

- In the frame design of the advance suspension the all four shockers are connected to two linkages and to the chassis frame.
- The shockers are having a cage like structure formed by linkage, which provide them load bearing capacity.
- There is a differential near to the engine which transmits power independently to both the rear wheels.
- The steering is formed with the tie rod which controls the vehicle turning.

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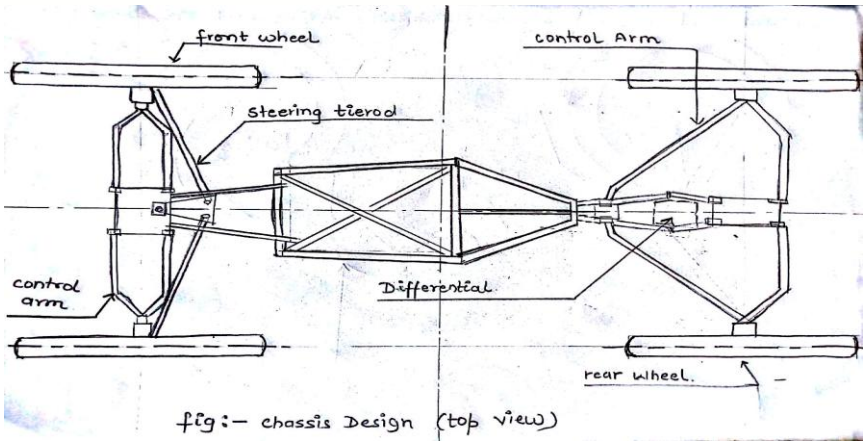

Fig 1: shows the sketch of chassis (top view)

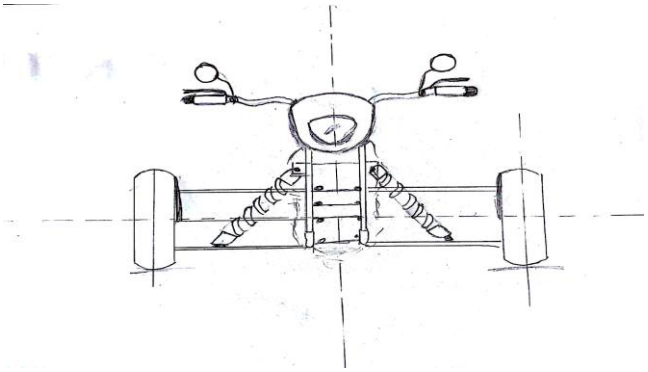

Fig 2: shows the sketch of vehicle (front view)

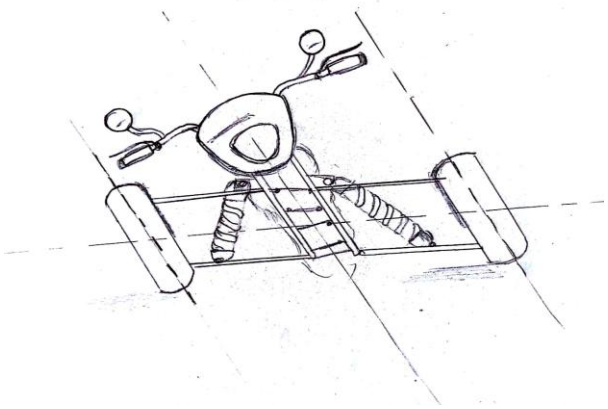

Fig 3: shows the sketch of vehicle in turning condition (front view)

VII ADVANTAGES

- It provides anti-skidding effect.
- Bike can be used for on road as well as for off road purpose.
- Assembly is reliable.
- Bolt on assembly gives redundancy to use vehicle as per requirement.

- Rider is safe while taking sharp turn on the road cause possibility of skidding or falling of bike is almost negligible.
- Normal people can take experience of off road biking.

VIII APPLICATION

- Off Road Driving.
- Can be suited for Handicapped People.
- Can be used in rainy season.

IX CONCLUSION

In study we have seen 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 can negate the forces coming on the vehicle at high speeds. This will produce anti skidding effect in the vehicle by which handicapped people can also enjoy the ride of bike. This bike will be more comfortable, stable as compared to conventional bikes.

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