

**WHEEL RIM SUSPENSION SYSTEM**

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Abstract:

The automobile has come to symbolize the essence of a modern industrial society. Recent technological improvements to comfort and vehicle design have begun to address these problems, at least at the level of the individual vehicle. This report highlights the technical aspects and the working of the advanced technologies used in the present or in the future automobiles. The wheel rim suspension in cars has reduced the space on the body. Inside the rim, the suspension systems are connected by using bell crank to change the direction of motion so that we have more space to connect the suspension system inside the rim. Due to less bumping space this type of suspension are mostly used in on-road vehicles. Unsprung mass is very less on this type of suspension compare to other types of independent suspension. In this type of suspension there is less number of linkages. It will more react to acceleration, deceleration and cornering. A final conclusion is drawn that once this technologies are in the market they will help to providing better modes of comfort also helps in reduction of space.

Introduction:

Suspension is the system of tires, tire pressure, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the them. It must support both road holding, handling and ride comfort quality which are at odds with each other.

Need of Suspension:

- Comfort
- Contact
- Control

Types of Suspension:

Rigid Axial Suspension: Rigid axle suspension systems are mainly designed for the rear of larger vehicles, such as the Dodge RAM. These systems have a solid beam that ranges between two wheels. If you hit a bump on the road, both tires will receive the same impact. This means you aren't going to get the same smooth ride that you would in a vehicle with an independent system. They can, however, carry heavier loads and are good for off roading and towing. They are commonly found in the larger 4x4 vehicles. In solid axle two wheels are tied together. The wheels can go up or down together-parallel bump motion. This makes a gyroscopic effect on the axle. The wheels can go move in opposite directions in roll motion. Axle has two degrees of freedom, four degrees of freedom must be restrained which can be expert using four tension-compression links.

Independent Suspension: The majority of passenger cars on the market today have an independent suspension system. These suspension systems allow the two wheels on the same axle to move independently from one another. One of the benefits of these systems is that because each tire will absorb the impact of the road separately, they provide easier handling and a smoother ride. Transverse arms and trailing arms confirm the desired kinematic behavior of the rebounding and jouncing wheels and also transfer the total impact loadings to the body. Lateral forces also generate a moment which, with unfavorable link arrangement, has the disadvantage of reinforcing the roll of the body during cornering. This has a anti-rolling bar and pan-hard rod to control the lateral force. The suspension control arms require bushes that yield under load and can also influence the springing.

Wheel Physics:

There are a few forces acting on the wheel. The normal reaction force between the wheels and the road. The weight of the car itself pushing the wheels down. Frictional force between the road and the wheels that tries to resist motion and acts in its opposite direction. Air resistance (Drag). Friction between the axle of the wheel and the parts around it. And all the other forces like the weight of the wheel, centripetal force, etc. when the car is stationery; there is a torque applied to the wheel and this is less than the "static friction force". When a torque on the wheel equal to the static friction is applied the wheel starts to rolling. And at that moment static friction disappears and a dynamic friction comes to stage and this is usually smaller than the static friction which makes rolling resistance on wheel. As long as the torque is equal to the resisting forces then the wheel rolls at a constant speed. And if a bigger force is applied the car accelerates at a rate proportional to the difference between the torque and dynamic friction + air + resistance. Longitudinal motive forces, Frictional forces from the ground and during braking. Normal reaction from the ground and the downward force due to weight of the car. Lateral forces act on the wheel while cornering.

Problem Identification:

The basic reason for working on such a topics arises from the automobile space constrain. In car body the suspension system has occupies more space. The four wheel of the car are not correctly response to the acceleration and deceleration of the car. For independent suspension the linkages are more and the drive shaft are need to design flexible.

Working Principle:

The wheel rim suspension works on the combination of wheel and suspension. Instead of wheel disc the suspension is mounted on the rim to the center. When the spring is used there will be up and down motion while travelling on the road. Bell

crank will change the direction of the motion of spring where all the spring are connected to the bell crank and the inside surface of the rim. While load acting on the on wheel the mounting of the wheel get misalign but the rotating center is same as the unload condition. The spring compression is change relate to the speed of the wheel for a same load condition.

Spring Diameter Variation: Spring is a long metallic wire of confident strength that is wound around a cylinder in a helical pattern creating equal gaps between two subsequent coils. Now when you compress a spring; the helix angle reduces which reduces the air gap also. So after full compression, air gap becomes nil (where the length on that stage is called solid length of a coil) hence the spring is compressed but it doesn't change the coil diameter or wire diameter. But on further compression, if allowed wire diameter decreases leading to a increase in wire length which is normally not allowed and the spring cracks or surge depending upon the material.

Control Action:

Roll Control: Roll Stability Control is a safety system which reduces the risk of rollover of the vehicles in some critical maneuvers such as severe cornering and during steering suddenly. This system is especially useful for the vehicles having the high centre of gravity (C.G.) like SUVs as they are more disposed to rolling over. While taking a turn, it may happen that the vehicle fails to keep contact with the ground & maintaining proper ground clearance causing in a rollover, if the maneuver is critical and is done at very high speed. In such a situation, Roll Stability Control comes into action. Where the anti-rolling bar and pan-hard rod is used to control the lateral force and avoid rollover.

Pitch Control: Pitch is a change in your vehicle's weight forwards or backwards. When it happens, the weight is moving from one end of the vehicle to the other - from the back to the front or from the front to the back during accelerating and braking. When you brake, it causes a drop in the front end in your car (inertia force act to forward) and lifts the rear end. This is more noticeable the harder you brake. When you accelerate, your front end is lifted (inertia force act to backward) as your rear end drops. Same as braking, this is more noticeable the faster you accelerate. It's especially noticeable when you're stopped and accelerate suddenly. So that's pitch! It's a pretty simple thing that you encounter every time you drive. Be sure to check out its buddies, yaw and roll. It may reduce by the suspension mounting with perfect castor angle on it.

Bounce Control: Suspension allows you to safely traverse uneven ground and bumps. The springs cope with acceleration, deceleration, turns and bumps, but the weight of the car controls oscillation. Still, the weight of the car alone cannot fully control oscillation, which can lead to wheel bounce. Wheel bounce is both difficult to control, and could even cause your vehicle to lose traction.

Yaw Control: A yaw rotation is a movement around the yaw axis of a rigid body that changes the direction it is pointing, to the left or right of its direction of motion. The yaw rate or yaw velocity of a car, aircraft, projectile or other rigid body is the angular velocity of this rotation, or rate of change of the heading angle when the aircraft is horizontal. It is commonly measured in degrees per second or radians per second. It may be reduce by make wheel toe-in.

Photography of the Project:



Figure: Isentropic View of Project



Figure: Front View of Project

Advantages:

Suspension mounting are inside the wheel rim make the more space reduction in cars. It has more road contact because of the centrifugal force as like on centrifugal clutch. It more reacts on pitching of car because there is no fixed castor angle, the castor may induced in all possible direction. It has less Unsprung mass because the linkage is less. Simple the axle step where the suspension is mounted in end of the axle.

Application:

The wheel rim suspension is used for passenger cars. Bumping wheels on industries. With more rim diameter it can be used as off road vehicles. It may be used in manufacturing industries.

Disadvantage:

In this type of suspension the bumping space is less compare to other independent suspension because of the spring is mount inside the rim .hence the bumping space is depends on rim diameter. Fixing of anti-rolling bar is difficult.

Conclusion:

Using is kind of technology we can improve the marketing value and in technical aspects of automobile we can improve the efficiency of a suspension. We may able to support the passenger to allow more space on the vehicles body. Making in large quantity is advisable and profitable.

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