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Design and Fabrication of Loop Wheel Bicycle

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ABSTRACT:In today's world, bicycles are the most preferable choice when it comes to causes like health, pollution, and environment. Also, the increase in cost of fuels has made it to think over bicycles as transportation option again. But at the same time comfort is also important. Several researches are going on in order to make the ride comfortable. Different types of bicycles are being developed for various applications like Mountain Bikes, Commuter Bikes and Racing Bikes. This report presents the concept of Loop Wheel Suspension which is designed such that the suspension system gets integrated within the wheel for higher shock-absorbing performance and better comfort to the rider. Loop Wheels offers a smoother ride. Loop Wheel springs are usually made up of a composite material carefully developed to offer optimum compression and lateral stability as well as strength and durability. But the high cost of composite materials has resulted into the need of the same system with other cheap materials. The system actually combines the support system and suspension system of the vehicle. The fixed hub of the ordinary bicycle is made to move according to the road conditions so as to absorb the shocks. The spring configuration permits the torque to be transferred smoothly between the hub and the rim.

KEYWORDS:Mountain Bikes, Loop Wheels, Strength, Durability

I. INTRODUCTION

A wheel is a circular part that is meant to rotate on an axle bearing. Wheels, in conjunction with the axles, enable heavy objects to be moved by simply providing movement. They are mainly used in transportation applications while supporting a load. Wheels are used for various alternative functions, such as a ship's wheel, steering wheel, automobile's wheel and flywheel.

A wheel greatly reduces friction by facilitating motion by rolling above a surface with the help of axles. For the wheels to rotate, a moment has to be applied to the wheels. The moment is provided about its axis, either by means of gravity or by applying an external force or torsion. From ancient times to 21st century, the wheels are

continuously going under evolution. Today wheel is an essential part of most of the machines in form of cams, bearings, sprockets, pulleys, gears and other rotating devices. But mostly wheels are used for transportation and many inventions related to the design of the wheel are going on to increase its performance. This report includes the most recent evolution in design of the wheel.

An idea to combine the suspension and support system of the wheel has given rise to a concept called 'Loop Wheel'. Loop Wheel is a new concept wheel for a bicycle. The spokes of a conventional wheel have been replaced with the loops of elliptical shape. These loops not only attach the outer rims to the centre hub but also provide suspension. The result is maximum comfort over bumps and less vibration from the road, thus providing a comfortable ride to the driver and passengers.

This report is focusing on designing the loop wheel for a bicycle having average wheel size of 24 inches. The existing system involving a wheel of 14 inches and the loops of carbon fibre material is not compatible with ordinary bicycles.

Also the carbon fibre material used is too costly to be used in a bicycle. It's actually not beneficial to change the whole design of bicycle just to provide a good suspension. The cost of such bicycle is not affordable to a common man.

II. LITERATURE REVIEW

1] The stresses and deflection in the composite leaf spring are compared to steel leaf spring. They used E- glass-Epoxy, Carbon - Epoxy, and Boron-Aluminum composites against the conventional 55si2Mn90 steel. The FEM method is used for finding deflection and von- Mises stresses in spring using ANSYS. The model of leaf spring is analyzed using ANSYS in different loading conditions.[1]

2] This research focused on ergonomics of city bicycle. City bicycles should be designed as per urban road conditions. According to this research recumbent bicycle using Short Wheel Base (SWB) was selected as the best concepts instead of conventional bicycle. In this research they also focused on developing its compatibility with standard bicycle to improve its manufacturability and maintainability. From this they created bicycle prototype. For the frame material steel is used as it has less cost, high manufacture ability and high formability more than other materials that highly recommended for city bicycle. But the drawback of this system is that its prototype has 50% more weight than conventional bicycles. This is happened because frame geometry is not considered while designing prototype[2]

3] In this paper author discussed front and rear wheel bicycle suspension corresponding to the rider comfort and peddling effort while riding on different road conditions. Human body acceleration and vibration frequencies are considered as comfort criteria. This analysis is done in software ADAMS which is used to analyze human body vibration and leg muscle forces of bicycle riding. According to analysis suspension system of bicycle can effectively reduce the vibration of human body.[4]

III. NECESSITY OF THE PROJECT

The wheels which are used in normal practice are nothing but 'Spoke Wheels'. They can carry loads more than hundred times of their own weight. But in off-road bicycling, skilled riders often jump from high obstacles which results in subjecting their wheels to forces of more than a quarter ton. That much extensive force on the wheels causes impact and transmits large shocks to the driver. This makes the ride completely uncomfortable. To make sure that the driver is in comfort, it is necessary to absorb the shocks with a greater extent

IV. METHODOLOGY

i. Literature Survey

Taking into consideration existing loop bicycle with carbon fibre material, the extensive literature survey is made by referring books, research papers, journals and conference.

ii. Design of Loops and other components

This includes the design of main component of bicycle i.e. Loop and secondary components like chain and sprocket. All the considerations and formulae used in design are referred from standard design data books.

iii. Modelling

By referring the existing system, a proposed design is finalized. The respective 3D model of the loop wheel is created in CATIA V5. The model is then used for carrying out simulations on the designed system.

iv. Fabrication of Loop Wheel Suspension system

By eliminating the spokes of bicycle wheel, loops are installed into the wheels. A triangular hub is used to support the loops. The axles of both wheels are mounted as per requirement such that the bicycle will provide good suspension.

V. CONSTRUCTION

After manufacturing all the components the assembly procedure is started. The steps followed for assembly are as given below:

1. Bolt the rim support to the wheel rim and insert the air valve.
2. Weld all the three loops to the triangular hub.
3. Place the hub-loop assembly inside the wheel.
4. Weld the loops to the rim support at appropriate locations.

5. Mount the tyre tube on wheel rim.
6. Place the wheel hub on axle and bearing.
7. Mount front and rear wheels onto the frame brackets.
8. Assemble the chain on sprocket and attach the pedal to crank arm.
9. Locate the brake pads such that it makes contact with the rim without interference.



Fig 5.1 Loop Wheel Bicycle Construction

VI. WORKING

While using spoke wheels in day to day routing life wheel's shock absorption is very low and the rider can feel it. Loop wheel is the solution we can get some hope on. Loop wheel has three springs/strips which work as suspension system. The spring system of these three between cycle's hub and rim of the wheel provides constant suspension to uneven terrain and potholes in the road, cushioning the rider from bumps. The hub floats between the rim and adjusting constantly as bumps and shocks from the uneven surface hit the rim of the wheel. The strips arrangement allows the torque to be transferred smoothly between the hub and the rim. Each wheel has a regular hub with a hub brake and hub gearing. Instead of spokes however three looped carbon composite springs are placed onto the hub. Whenever the wheel hits a bump in the road, the energy is absorbed by that spring. We try to create loop wheel with considering the weightage of cycle and rider to be equally distributed over the wheels of the bicycle. Compression rate is kept same for each loop wheel to be designed.

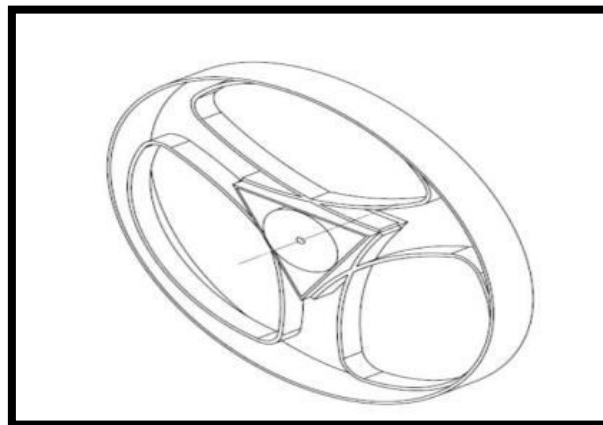


Fig 6.1 Loop Wheel

The invention of wheel has a great value when it came to as a load carrying device. Today the wheel is an essential part of most machines in the form of gears, pulleys, cams, sprockets, bearings, and other rotating devices. After so much time passed wheel is still most conspicuous as a load carrier and from a technical view, the bicycle wheel is one of the elegant one. More than a century ago world has been introduced by the wire spoked bicycle which replaces wooden wheels with thick and rigid spokes. By tensioning the wires, made that wheels possible and with this technique light weight vehicles are introduced to the world Wire spoke genuinely make lot of difference in the wheels future. They not only reduced weight of the wheels but also improved durability. The wheels now can carry weights hundred times more than their own weight. Also in off-road bicycling, trained cyclist always has to face tons of obstacles with lots of forces acting on wheels from each side. But whoever tries to understand the mystery behind the unusual strength of bicycle are making bicycle ride more comfortable with making changes in suspension system. The big change is by introducing tangential suspension system in wheel itself which can absorb shocks from all the direction. All shocks has to pass through the centre of the wheel i.e. Hub. In basic design of bicycle, hub is fixed with rigid spokes joined to rim which practically doesn't take any part in providing suspension. By understanding importance of hub, it has been given the ability to move back and forth. This is happening by replacing settled spokes with springs like material which has damping capacity. A spring made of metal bended like a leaf spring clamped individually utilized for the suspension.

VII. ADVANTAGES

1. Better shock-absorbing performance
2. Greater comfort, Smoother ride
3. More comfortable than standard wheels
4. They are extremely strong as compared to other wheel

VIII. DESIGN OF LOOP WHEEL

This chapter gives details about the design and modeling of the Loop Wheel Suspension system. The main focus is on designing the loops which are going to be assembled in the wheel. Apart from that chain and sprocket design is also included.

The loop wheel is designed by considering it as a leaf spring. The main concern is to reduce the shock and to provide maximum comfort to rider. A leaf spring is a simple form of spring commonly used for the suspension in wheeled vehicles. Originally called a laminated or carriage spring and sometimes referred to as a semi elliptical spring or cart spring, it has high shock absorbing capacity along with high stiffness. That's why the loops are designed by considering them as leaf springs.

The main target was to achieve the desired deflections in the suspension for a particular weight of driver. The Loop Wheel is designed in such a way that the suspension system is integrated within wheel for higher shock- absorbing. It reduces weight as well as it improves aesthetics of bicycle. Considering the application C20 material is selected for the loops.

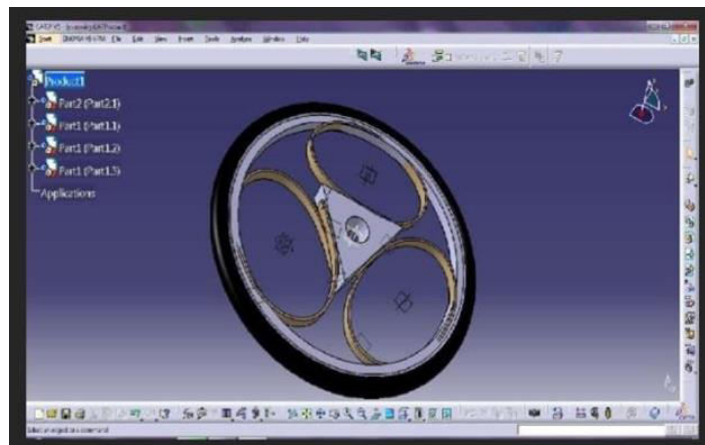


Fig.8.1 3D design of Loop Wheel

IX. FUTURE SCOPE

In this project we will design and fabricate a loop-wheel bicycle which will be able to have extra feature of shock absorption and also the better load bearing capacity. The project will contain a bicycle with an improved wheel. The wheel will be replaced from conventional spoked-rim system to leaf spring or loop spring. The wheel will consist Axle, Hub, Rim, Tyre and Leaf/loop springs. All parts will be mounted in wheel so as to maintain its center of gravity.



Fig 9.1 Loop Wheel bicycle

X. RESULTS AND CONCLUSION

We successfully make a project of Design and fabrication of loop wheel bicycle. Loop wheel bicycle is provide better suspension for off-road cycling. It does not produce any type of pollution which will affect to the environment. We design such type of loop wheel bicycle to provide comfort and smooth driving for the person. Loop Wheels offers a smoother ride. Loop Wheel springs are usually made up of a composite material carefully developed to offer optimum compression and lateral stability as well as strength and durability.

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