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Springless suspension system for an automobiles

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Abstract

The suspension system of an automobile plays a critical role in providing a smooth and comfortable ride while ensuring safety and stability. Traditional suspension systems commonly rely on mechanical springs for absorbing shocks and vibrations from the road. However, there is growing interest in springless suspension systems that utilize alternative technologies, such as bevel gears, for suspension and damping.

This paper presents an exploration of the use of bevel gears in springless suspension systems for automobiles. The advantages and challenges of using bevel gears in place of traditional springs are discussed. Bevel gears offer a compact and lightweight solution, precise control over suspension characteristics, and potential reduction in complexity and maintenance requirements. However, challenges such as design complexities, durability and reliability issues, and increased cost need to be addressed.

The principles of bevel gears and their application in suspension systems are reviewed, and the current state of research and development in this area is highlighted. The proposed approach and methodology for further investigation are discussed, emphasizing the significance of this concept in advancing the field of automotive suspension systems.

Key Words : Springless suspension, Wear, Bevel gears, Self-aligning, Comfortable ride, Damping.

Introduction

The suspension system of an automobile is a critical component that plays a vital role in providing a smooth and comfortable ride, while ensuring safety and stability. Traditional suspension systems typically rely on mechanical springs for absorbing shocks and vibrations from the road. However, recent advancements in automotive technology have led to the emergence of springless suspension systems that utilize alternative technologies for suspension and damping, including the use of bevel gears.

Bevel gears are a type of gears that have a conical shape with intersecting axes. They are commonly used in mechanical power transmission systems, but they can also be employed in suspension systems to provide suspension and damping characteristics without the need for traditional springs. The use of bevel gears in springless suspension systems offers several potential advantages, including compactness, lightweight, precise control over suspension characteristics, and potentially reduced complexity and maintenance requirements.

This paper aims to explore the use of bevel gears in springless suspension systems for automobiles. It will discuss the advantages and challenges of using bevel gears in place of traditional springs, review the principles of bevel gears and their application in suspension systems, highlight the potential benefits and limitations of this approach, and discuss the current state of research and development in this area. The paper will also propose scan approach and methodology for further investigation,

components of our project are

- Bevel gears
- Rubber visa wheels
- mild steel plates
- Centershaft Dc motor 45 rpm
- 10mm stud
- Circuit

These components work together to achieve our project's goal.

1.Bevel gears

Bevel gears are a type of gears that have a conical shape and intersecting axes, allowing them to transmit rotational motion between non-parallel shafts. They are used in a wide range of applications, including automotive, aerospace, marine, and industrial machinery. Bevel gears are designed to mesh together at a specific angle, known as the "pitch angle" or "cone angle," which determines the gear ratio and the motion transfer characteristics

2. Rubber visa wheels

A springless suspension system for an automobile can be designed using bevel gears and components from rubber-visa wheels. Rubber-visa wheels, also known as airless or non-pneumatic wheels, are made from solid rubber or similar materials, eliminating the need for air-filled tires and providing a unique suspension capability. Bevel gears with cone-shaped teeth can be used to transfer power and torque from the vehicle's axle to the rubber-visa wheels, providing a form of suspension that absorbs shocks and vibrations. The rubber-visa wheels can act as flexible elements that deform and absorb impacts, providing a cushioning effect similar to traditional springs. Proper engineering design and calculations should be considered to ensure that the bevel gears and rubber-visa wheels are appropriately integrated into the suspension system to provide the desired performance, stability, and comfort for the specific application in the automobile. Testing and validation should also be conducted to ensure the safe and reliable operation of the springless suspension system using the bevel gears and components from rubber-visa wheels

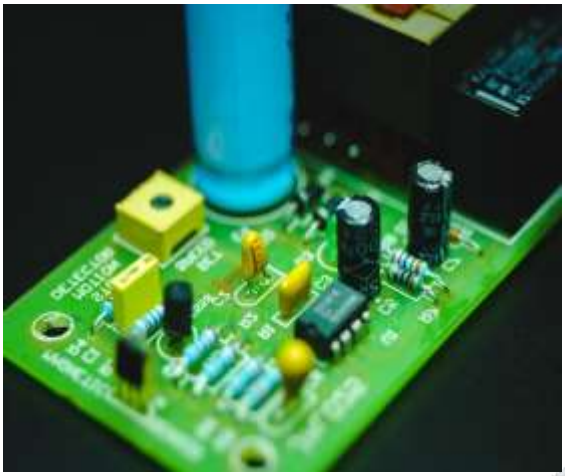
3.Mild steel plates

Mild steel plates, also known as low carbon steel plates, are widely used in a variety of applications due to their high strength, durability, machinability, and cost-effectiveness. They are commonly used in structural applications, automotive and transportation manufacturing, machinery and equipment fabrication, storage tanks and containers, construction and infrastructure projects, energy and power generation equipment, and general fabrication, such as welding and machining. Mild steel plates provide structural support, corrosion resistance, and versatility, making them suitable for a wide range of industries and purposes. Proper engineering design and material selection should be considered to ensure that mild steel plates are used appropriately for their intended purpose.

4.Centershaft Dc motor 45 rpm

A springless suspension system for an automobile can be designed using bevel gears and components from a center shaft DC motor with a rotation speed of 45 RPM. Bevel gears with cone-shaped teeth can be used to transfer power and torque from the motor to the suspension system, eliminating the need for traditional springs. The center shaft DC motor can provide the necessary rotational motion for the suspension system to function. Components from the motor, such as the gears, shafts, and housing, can be repurposed and modified to serve as integral parts of the suspension system. Proper engineering design and calculations should be considered to ensure that the bevel gears and motor components are appropriately integrated into the suspension system to provide the desired performance, stability, and durability for the specific application in the automobile. Testing and validation should also be conducted to ensure the safe and reliable operation of the springless suspension system using the bevel gears and components from the center shaft DC motor with a rotation speed of 45 RPM.

5.Circuit



A springless suspension system for an automobile can be designed using bevel gears and components commonly used in electronic circuits. Bevel gears with cone-shaped teeth can be utilized to transfer power and torque from the vehicle's axle to the suspension system, providing a mechanical means of absorbing shocks and vibrations. Components such as gears, shafts, and housings used in electronic circuits, such as printed circuit boards (PCBs), can be repurposed and modified to serve as integral parts of the suspension system. For example, PCB materials can be used to create flexible elements that deform and provide cushioning effects similar to traditional springs. Proper engineering design and calculations should be considered to ensure that the bevel gears and electronic circuit components are appropriately integrated into the suspension system to provide the desired performance, stability, and durability for the specific application in the automobile. Testing and validation should also be conducted to ensure the safe and reliable operation of the springless suspension system using the bevel gears and components from electronic circuits.

Construction

A springless suspension system for an automobile can be designed using bevel gears in its construction. Bevel gears, which have cone-shaped teeth, can be used to transfer power and torque from the vehicle's axle to the suspension system, providing a mechanical means of absorbing shocks and vibrations. The bevel gears can be arranged in various configurations, such as worm gears or helical gears, to create a suspension system that can effectively dampen vibrations and impacts from uneven road surfaces. Proper engineering design and calculations should be considered to determine the appropriate gear ratios, tooth profiles, and placement of bevel gears in the suspension system to achieve the desired performance and stability. The construction of the springless suspension system using bevel gears can provide advantages such as reduced weight, simplified design, and potentially lower cost compared to traditional spring-based suspensions. Testing and validation should be conducted to ensure the safe and reliable operation of the bevel gears-based springless suspension system in the automobile, taking into account factors such as load capacity, durability, and safety requireme

Working

The Springless Suspension System Combines a differential mechanism and an oscillating system. A differential is a gear train with three drive shafts that has a property such that the rotational speed of one shaft is the average speeds of the others, or a fixed multiple of that average and Oscillation is the repetitive.
The Frame of the system is mostly made of Mild steel. The frame that holds the tires oscillates freely. The same frame is connected to the differential.
A motor is connected to a gear in the differential mechanism, thereby making it the driving gear. The driving gear is connected by bevel gear on both the side. Each gear is connected to two wheels on each side. Each wheel is driven by an individual motor. The motor makes sure that the gears and the wheels are in motion and the oscillating property makes sure that the vehicle is moving forward even in rough terrain.

Advantages:

- Reduced Weight
- Improved Performance
- Increased Durability
- Simplified Design

Disadvantages:

- Validation and Testing Challenges
- Potential Durability Concerns
- Potential Increased Cost

Application:

- Electric Vehicles
- High-Performance Vehicles
- Off-Road Vehicles
- Military Vehicles

Design of bevel gear Calculation:

δ1 = pitch angle for pinion
δ2 = pitch angle for gear
θ = angle between two axes of the shaft
d1=pitch diameter of pinion
d2=pitch diameter of gear
Z1=number of the teeth in pinion
Z2=number of the teeth in gear
σd1= σd2=allowable static stress
N1=N2=speed
i = velocity ratio
data:
d1=50mm
d2 = 50mm
z1=z2=32
σd1= σd2=52.8N/mm2
N1=45rpm
i =d2/d1=z2/z1=N1/N2
i=1
N2=45rpm

1. **Identification of weaker part**

Since both pinion and gear is made up of some material so pinion is weaker.
Since angle is not given assumed it as 90degree

For right angle bevel gears

The pitch angle of pinion tanδ1 =1/i=1
δ1 = tan $^{-1}$(1)
δ1 =45degree
δ2 =45degree
effective number of the teeth Ze1=Z1/Cosδ1=32/Cos45
Ze1=45.25
Ze2=Z2/cosδ2=45.25
For 32 teeth α=14 ½ degree FDI from DHB

2. **To find module**

Ft = ((L-b)/L)

M=Ft/ σdCvbYe(L/L-b)

V1 = πd1N1/60

L=1/2($\sqrt{d1^2}$+$\sqrt{d2^2}$)=1/2($\sqrt{50^2}$+$\sqrt{50^2}$)

L=35.5mm=36mm

Ft=1000PCs/V=1000*24.24/0.117=207.1N

b=L/3=36/3=12mm

Ye1=(0.124-0.684/ze1) for 14 ½ degree FDI
=0.124-0.684/45.24
Ye1=0.1088
Cv= 6.1/6.1+v
=6.1/6.1+0.117
=0.9811
M=4.12
M=5mm
To check for the stress σd
Ft= σdCvbym((L-b)/L)
σd = Ft/Cvbyem((L/L-b)
=207.1/0.98*12*0.1088*5(36/36-12)
σd1=48.55<58.1 N/mm2

to find dynamic load Fd

Fd=Ft +K3V(Cb+Ft)/K3V+$\sqrt{Cb + Ft}$

To find C at V=0.117m/s

Assume V=10m/s

Since dynamic factor for plastic is not available in data hand book so trial and error method is adopted

Cast iron σd=138.3N/mm2

Steel σd=207.6n/mm2

Plastic σd=58.8N/mm2

C.I σd=138 steel σd=207.6

Plastic σd=58.8 plastic σd=58.8

V=0.11

Then C=10to20

Fd=252.88N

To find endurance strength

Fen= σenbym(L-b/L)

σen=41.0mpa for non metallic

Fen=41*12**0.1088*5(36-12/36)

Fen=535.29

Fd<Fen the gears are safe for continuous operation

Wear calculation

Fw=d1bQeK/Cosδ1

Qe=2Ze2/Ze2+Ze1

=2*45.24/45.25+45.25

Qe=1

For safe design Fw>=Fd then d1bQeK/cosδ1 >Fd

K=(252.88*Cos45)/50*12*1

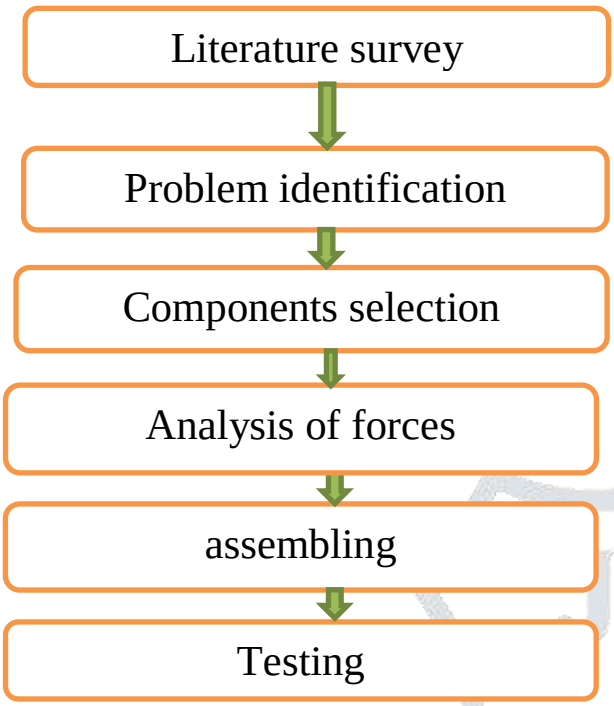
K=0.298

Fw=d1bQeK/Cosδ1

= (50*12*1*0.298)/Cos45

Fw=252.86

Methodology



1. Literature survey: from various authors journals we studied to solve the springless suspension for an automobiles
2. Problem identification: as when we go through various journals paper we found some problems in spring suspension system to over come from those problems we selected a bevel gear suspension system
3. components selection : Bevel gears, Rubber visa wheels ,mild steel plates , dc motors , two links and circuit
4. Analysis of forces: Find the forces acting on the each component of the machine and the energy transmitted by each component.
5. Assemble: assembling all components in proper way to get the desired product
6. Testing : The final obtained product can be tested in all possible ways

LITERATURE SURVEY

1. Engr.Rufus Ogbuka Chime has prepared Design, Modeling, Application and Analysis of Bevel Gears and published in Int. Journal of Engineering Research and Applications ISSN (online): 2248-9622, Vol. 6, Issue 4, (Part - 3) April 2016, pp.44-52, with the project title of "Design, Modeling, Application and Analysis of Bevel Gears" Bevel gears are gears where the axes of the two shafts intersect and the tooth bearing faces of the gears themselves are conically shaped. Bevel gears are most often mounted on shafts that are 90 degrees apart, but can be designed to work at other angles as well. The pitch surface of bevel gears is a cone. Two bevel gears in mesh is known as bevel gearing. In bevel gearing, the pitch cone angles of the pinion and gear are to be determined from the shaft angle, i.e., the angle between the intersecting shafts.

2. Munjal Mehta has prepared SPRINGLESS TYPE MAGNETIC SUSPENSION and published in International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056 Volume: 05 Issue: 01 | Jan-2018 www.irjet.net p-ISSN: 2395-0072 with the project title of "springless type magnetic suspension" magnetic suspension is technology for supporting an object without contact by means of a magnetic force. Magnetic suspension system have many advantages like It provides more stable effect, Friction is very Less possibility for direct shock etc. So far, many kinds of magnetic levitation systems have been proposed and developed. These magnetic levitation system use various methods to control the suspension force.

3. JAYESH H. DESHPANDE has prepared Prototype of 90degree steering mechanism and published in International Research journel of Recent Technology and engineering JETIR February 2020, Volume 7, Issue 2 www.jetir.org (ISSN-2349-5162) with the project title of " Prototype of 90 degree steering mechanism" .an effort is made on the development of 90 degree steering mechanism which will turn the wheels by 90 degrees. The proposed approach is to construct a vehicle whose wheels can turn 90 degrees by using an additional rack and pinion type steering mechanism for the rear wheels in addition with front wheels. Rear wheel steering mechanism will come into action at the time of parallel parking and can be engaged and disengaged with the help of lever which operates the engagement and disengagement of gears.

4. Bhar wad Jayesh Mela Bhai has prepared Design and Analysis of Suspension System for Light Weight Vehicle and published in the IJARIIE-ISSN(O)-2395-4396 Vol-6 Issue-3 2020 with the project title of " Design and Analysis of Suspension System for Light Weight Vehicle" .An Independent wheel suspension system is used nowadays in almost all new modern cars. The conventional system which uses dependent suspension is not of much use as it creates more jerk in the car body. Normally, when any bump or hindrance comes across the vehicle, the suspension system reduces the disturbance in the car. The dependent system is connected with chassis and car body frame. So with any jerk, the car body faces the disturbance. In Independent wheel vehicle suspension, the spring is connected with the wheel, which absorbs all shock and does not allow any jerk in the car body.

5. John Argyris has prepared Computerized integrated approach for design and stress analysis of spiral gear and published in Elsevier in the year January 2002, volume 191 ,issues 11-12 on pages 1057-1095An integrated computerized approach for synthesis, analysis and stress analysis of enhanced spiral bevel gear drives is proposed. The approach is accomplished by application of computerized methods of local synthesis and simulation of meshing and contact of gear tooth

6. Y.C.Tsai has prepared surface geometry of straight and spiral bevel gears and published in Journel of Mechanicals,Transmissions and Automation in design and for the year December 1987 of volume 109, Issue The mathematical modeling of the tooth surface geometry of bevel gears can be developed based on the basic gearing kinematics and involute geometry along with the tangent planes geometry. The parametric representations of the spherical involute and the involute spiroid, which are the tooth surface geometry of straight bevels and spiral bevels, respectively, have been derived in this paper.

7. J. Mech. Des has prepared Load distribution in spiral bevel gears and published in Journal of Mechanical Design Volume 129, Issue 2 in the year February 2007.The tooth deflections of the pinion and gear teeth are calculated by the finite element method. As the equations governing the load sharing among the engaged tooth pairs and load distribution along the tooth face are nonlinear, an approximate and iterative technique is system of equations.

Conclusion

In conclusion, the concept of springless suspension of an automobile using bevel gears holds promise as a potential innovation in the field of automotive suspension systems. The use of bevel gears as a mechanical means of providing suspension without the need for traditional springs or dampers offers advantages such as reduced weight, simplified design, and potentially improved performance in certain conditions. However, there are challenges and limitations to be addressed, such as the need for precise gear design and manufacturing, potential noise and vibration issues, and the need for comprehensive testing and validation. Further research and development efforts are required to fully explore the potential of springless suspension using bevel gears, including investigations into different gear configurations, materials, lubrication methods, and real-world performance. With continued advancements in technology and engineering, springless suspension using bevel gears could potentially become a viable option for future automotive suspension systems, offering improved ride comfort, handling, and overall vehicle performance.

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