Bevel Gear Suspension System

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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.**

Keywords---sensitive: Springless suspension, Wear, Bevel gears, Self-aligning, Comfortable ride, Damping

I. INTRODUCTION

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, recent 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 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

COMPONENT OF OUR PROJECT ARE

- BEVEL GEARS
- RUBBER VISA WHEELS
- SUPPORTIVE FRAME OF WOOD
- CENTERSHAFT DC MOTOR 65 RPM
- L298N MOTOR DRIVER MODULE
- HC-05 BLUETOOTH MODULE
- UNO R3 SMD BOARD ATMEGA328P

II. 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.

Fig: Bevel Gear

III. 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

Fig: Rubber Visa Wheels

IV. SUPPORTIVE FRAME OF WOOD

Wood of 10 x 10 inch. 1.1". We have assembled the model Accessories in such a way in which a white board of 10 × 10 size is used as a base upon which Arduino Bluetooth initiator switch is attached using double sided tape. The complete mechanism is supported using four 12 inches well welded iron rods.

V. DC MOTOR 60rpm

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 60 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 60 RPM.

VI. HC-05 BLUETOOTH MODULE

Wireless communication is swiftly replacing the wired connection when it comes to electronics and communication. Designed to replace cable connections HC-05 uses serial communication to communicate with the electronics. Usually, it is used to connect small devices like mobile phones using a short-range wireless connection to exchange files. It uses the 2.45GHz frequency band. The transfer rate of the data can vary up to 1Mbps and is in range of 10 meters. The HC-05 module can be operated within 4-6V of power supply. It supports baud rate of 9600, 19200, 38400, 57600, etc. Most importantly it can be operated in Master-Slave mode which means it will neither send or receive data from external sources.

Fig: HC05 Bluetooth module

VII. L298N MOTOR DRIVER MODULE

This **L298N Motor Driver Module** is a high power motor driver module for driving DC and Stepper Motors. This module consists of an L298 motor driver IC and a 78M05 5V regulator. **L298N Module** can control up to 4 DC motors, or 2 DC motors with directional and speed control. The L298N Motor Driver module consists of an L298 Motor Driver IC, 78M05 Voltage Regulator, resistors, capacitor, Power LED, 5V jumper in an integrated circuit.

VIII. UNO R3 SMD BOARD ATMEGA328P

Arduino UNO SMD is a microcontroller board based on the ATmega328P. It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator, a USB connection, a power jack, an ICSP header and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started.
The "SMD" stands for surface-mount device, and the microcontroller (ATmega328p) is soldered directly to the board.

Fig: UNO R3 SMD BOARD ATMEGA328P

IX. LITERATURE SURVEY

A. Rufus Ogbuka Zvonkohra, an engineer, completed the design work for an application that uses mathematical models and methods to study and evaluate bevel gears. A paper called "Implementation of Bevel Gear Modeling and Analysis Application" was released in the International Journal of Engineering Research, Vol. The article is the fourth part of the sixth issue of the journal, which was published online in April 2016. The gear range is from 44 to 52. When two shafts intersect, bevel gears with conical tooth surfaces are employed. They can be configured to work at different inclinations, but they are usually mounted on shafts that have a right angle. The chamfer is the flat edge of the bevel gear. The angle of the pinion and gear for bevel gears is decided by the shaft angle, which is the angle where the shafts cross.

B. A spring-type magnetic suspension was developed by B. Munjal Mehta and published in the International Research Journal of Engineering and Technology (IRJET) in January 2018 (www.irjet.net; p-ISSN: 2395-0072); e-ISSN: 2395-0056; Year: 05 Issue: 01 "Springless Magnetic Suspension" is the name of the project. The magnetic suspension technique uses a magnetic force to hold an object without physical contact. The magnetic suspension system offers a number of advantages, including a more stable result and a very low chance of direct impact due to friction. Many types of magnetic levitation devices have been created so far. These magnetic levitation devices use different techniques to regulate the suspension force.

C. 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

D. 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 Basic gear kinematics, involute geometry, and tangent plane geometry can all be used to build mathematical models of bevel gear tooth surface geometry. The parametric representations of the straight bevel and spiral bevel tooth surface geometries of the spherical involute and the involute spiroid were derived in this study

E. 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 finite element method is used to calculate the tooth deflections of the gear and pinion teeth. A system of approximation and iteration equations is used to control the load distribution along the tooth face and the load sharing between the engaged pairs of teeth since these equations are non-linear.

F. F. Jayesh Under the project name "90 Degree Steering Mechanism Prototype", H. DESHPANDE created a steering mechanism prototype which was published in the International Research Journal of Recent Technology and Engineering JETIR February 2020, Volume 7, Number 2 www.jetir.org (ISSN-2349 -5162). An attempt is being made to create a steering mechanism that could turn the wheels 90 degrees. The proposed method is to build a car with wheels that can turn 90 degrees by adding a second rack and pinion steering mechanism to the front and rear wheels. When parallel parking, the rear wheel steering mechanism is activated. The lever that controls the on and off of the mechanism.

which operates the engagement and disengagement.

X. 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 requirement.

XI. WORKING

In your springless suspension system, shocks are absorbed through the rotation of the bevel gears. When the vehicle encounters bumps or rough terrain, the wheels attached to the bottom sides of the frames experience upward or downward forces. These forces are transmitted through the frames to the bevel gears. The bevel gears are connected in such a way that they can rotate independently of each other. As one wheel moves up or down, it causes the corresponding bevel gear to rotate. This rotation transfers the energy of the shock into rotational motion, which is absorbed by the gears. Since the bevel gears are connected to each other and to the frames via bolts, the rotational energy is distributed across the system, reducing the impact felt by any single component. This helps to smooth out the ride and protect the vehicle chassis from damage. Overall, the bevel gear mechanism effectively absorbs shocks by converting them into rotational energy. The differential which consists of a gear wheel with three drive shafts and the characteristic that the speed of rotation of one shaft is equal to the average speed of the others or a fixed multiple of this diameter is combined with an oscillating system and forms a springless suspension system the oscillation is repeated the frame of the system is mostly made of mild steel the frame that carries the tires oscillates freely and is connected to the differential by a motor that is attached to the gear of the differential mechanism making it the drive gear each bevel gear on either side of the drive gear connects it to two gears on each side of the driven gear. Each wheel has its own motor that powers it. Even on rough terrain, the oscillation function ensures that the vehicle continues to move forward, while the engine ensures that the wheels and gears keep turning.

Fig. Project Final Image Side View

ADVANTAGES

1. Enhanced Ride Comfort: Springless suspension systems with bevel gears can provide improved ride comfort by actively adjusting the suspension characteristics in real-time. This allows for better shock absorption, reduced vibrations, and smoother ride quality, resulting in a more comfortable driving experience for occupants.
2. Improved Handling and Stability: Active suspension systems using bevel gears can dynamically adjust the suspension settings to optimize vehicle stability and handling. By adapting to changing road conditions and driving dynamics, these systems can enhance traction, minimize body roll, and improve overall vehicle control and stability.
3. Customizable Driving Modes: Springless suspension systems often offer multiple driving modes or settings that allow drivers to customize the suspension response according to their preferences or specific driving conditions. This versatility enables drivers to switch between comfort, sport, or off-road modes, tailoring the suspension characteristics to suit their needs.

DISADVANTAGE

1. Cost: Springless suspension systems using bevel gears are generally more complex and expensive compared to conventional suspension systems. The incorporation of electronic sensors, actuators, and control systems adds to the overall cost of the system.

2. Maintenance and Complexity: The advanced technology and complexity of springless suspension systems require specialized maintenance and diagnostic procedures. If any component of the system malfunctions or requires repair, it may involve higher costs and technical expertise.
3. Power Consumption: Active suspension systems utilizing bevel gears and electronic control systems consume electrical power to operate. This additional power demand can impact fuel efficiency and overall energy consumption of the vehicle.

APPLICATIONS

1. Off-Road Vehicles: The adaptability and enhanced traction provided by springless suspension systems make them suitable for off-road vehicles, allowing for better control and stability on uneven or challenging terrains.
2. Sports Cars: Active suspension systems using bevel gears can be found in sports cars, where precise handling, stability, and agility are of utmost importance.
3. Electric and Hybrid Vehicles: Springless suspension systems can be utilized in electric and hybrid vehicles to optimize ride quality and compensate for the additional weight of the battery packs.

XI. METHODOLOGY

i. Literature survey

ii. Problem identification

iii. Assembling

iv. Testing

v. Components selection

a. Literature survey: from various authors journals we studied to solve the springless suspension for an automobiles

b. 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

c. Components selection : Bevel gears, Rubber visa wheels, wood plates, dc motors, two links and circuit

d. Analysis of forces: Find the forces acting on the each component of the machine and the energy transmitted by each component

e. Assemble: assembling all components in proper way to get the desired product

f. Testing: The final obtained product can be tested in all possible ways

XII. CONCLUSION

[1] 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.
[2] 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.
[3] 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.
[4] 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.
[5] 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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