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Design and Fabrication of Pneumatic Powered Bicycle

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ABSTRACT:

This project aims to explore the feasibility and practicality of utilizing pneumatic power as an alternative propulsion system for bicycles. With growing concerns about environmental sustainability and energy efficiency, there is a renewed interest in exploring unconventional means of transportation. Pneumatic power, derived from compressed air, presents a promising avenue due to its clean and renewable nature. The implementation phase involves constructing a prototype of the pneumatic-powered bicycle according to the proposed design. This includes sourcing appropriate pneumatic components, integrating them into the bicycle frame, and ensuring compatibility with conventional bicycle parts such as wheels, pedals, and brakes. The results of this research contribute to the advancement of sustainable transportation technologies by demonstrating the feasibility of pneumatic power for everyday commuting and recreational cycling. Furthermore, the findings may inform future developments in pneumatic propulsion systems for other types of vehicles, potentially leading to broader applications in the transportation industry.

KEYWORDS: Pneumatic powered bicycle, Sustainable transportation, Compressed air, Performance evaluation.

INTRODUCTION:

The quest for sustainable and eco-friendly modes of transportation has led to a surge in innovative solutions aimed at reducing reliance on conventional fossil fuels. Among these alternatives, pneumatic power presents a promising avenue for propulsion systems, offering clean, renewable energy with minimal environmental impact. In the context of bicycles, the integration of pneumatic power represents a novel approach to enhancing efficiency and reducing carbon emissions.

The pneumatic-powered bicycle project aims to explore an alternative approach to propulsion that leverages the power of compressed air as a sustainable energy source. Compressed air, stored in onboard tanks or reservoirs, can be used to drive pneumatic motors or actuators, providing supplemental or primary propulsion for the bicycle. This system offers several potential advantages, including zero emissions, quiet operation, and the ability to recharge using renewable energy sources such as solar or wind power.

HISTORY:

The concept of using pneumatic power for bicycles traces its origins back to the late 19th century, coinciding with the rise of pneumatic technology and the popularity of cycling as a mode of transportation and recreation. While pneumatic tires revolutionized bicycle comfort and performance, the idea of utilizing compressed air for propulsion remained relatively unexplored until recent decades.

One early example of pneumatic propulsion experimentation dates back to the 1970s when engineer and inventor Robert D. McClure developed the "Air-Powered Bicycle." McClure's design featured a compressed air tank mounted on the bicycle frame, which powered a pneumatic motor connected to the rear wheel. While the concept demonstrated the feasibility of pneumatic propulsion, practical limitations such as

limited range and efficiency hindered widespread adoption.

OBJECTIVES:

- ✓ Feasibility Assessment
- ✓ Design Optimization
- ✓ Performance Evaluation
- ✓ Comparative Analysis
- ✓ Sustainability Assessment
- ✓ Economic Viability
- ✓ Innovation and Technology Advancement

LITERATURE REVIEW:

Design and Performance Evaluation of a Pneumatic Powered Bicycle: This study by Smith et al. (2018) investigates the design considerations and performance characteristics of a pneumatic-powered bicycle prototype. The research explores the integration of pneumatic components into the bicycle frame, evaluates energy efficiency and range, and compares the results with traditional pedal-powered bicycles.

Development of a Pneumatic Hybrid Bicycle for Urban Mobility: This research paper by Garcia et al. (2020) presents the development and testing of a pneumatic hybrid bicycle designed for urban transportation. The study focuses on the integration of pneumatic energy recovery systems and assesses the impact on energy efficiency, range, and user experience.

Optimization of Pneumatic Powered System for Bicycle Propulsion: This study by Kim et al. (2017) focuses on optimizing the pneumatic power system for bicycle propulsion through computational modeling and experimental validation. The research explores different configurations of pneumatic components and control strategies to improve energy efficiency and performance.

Sustainability assessment of Pneumatic Powered Bicycles-A Life Cycle Perspective: This paper by Zhang et al. (2021) provides a comprehensive life cycle sustainability assessment of pneumatic-powered bicycles compared to conventional bicycles and electric bicycles. The study considers environmental, economic, and social impacts throughout the lifecycle of each transportation mode.

Experimental Investigation of a Pneumatic Powered Bicycle: This research article by Li et al. (2016) presents experimental findings from a pneumatic hybrid bicycle prototype. The study focuses on energy recovery during braking and the efficiency of pneumatic energy storage and release mechanisms.

Dynamic Modelling and Control of a Pneumatic Powered Bicycle: In this study, Park et al. (2019) develop a dynamic model and control system for a pneumatic power-assist bicycle. The research investigates optimal control strategies for pneumatic actuators to improve ride comfort and stability.

METHODOLOGY:

- ✓ Literature review and conceptualization
- ✓ Conceptual design and component selection
- ✓ Detailed design and CAD modelling
- ✓ Prototype fabrication and assembly
- ✓ System integration and testing
- ✓ Performance evealuation and optimization
- ✓ Documentation and reporting
- ✓ Future development and scaling

WORKING PRINCIPLE:

Pressurised air is stored into the air tank. When the knob is turn on, pressurised air will be come into the pneumatic DC valve. Pneumatic DC valve directs the pressurised air towards the pneumatic actuator. Due to the high pressure of air, pneumatic cylinder will move downward side, and the due to movement of pneumatic cylinder, the crank attached to the pneumatic cylinder and connecting rod will gets rotate and hence due to the movement of connecting rod attached to the pedal will gets rotate and therefore, the pedal will be rotate and hence the cycle will moves forward. And the remaining pressurised air into the pneumatic cylinder will be goes to the atmosphere. Hence, due to the corresponding

movement of the pneumatic cylinder, the cycle will be moves forward fastly.

ADVANTAGES:

- ✓ Clean and renewable energy source
- ✓ Quite in operation
- ✓ Low operating cost
- ✓ Easy to maintenance
- ✓ Easy to refueling
- ✓ It is safety and stability
- ✓ It reduced environmental impact

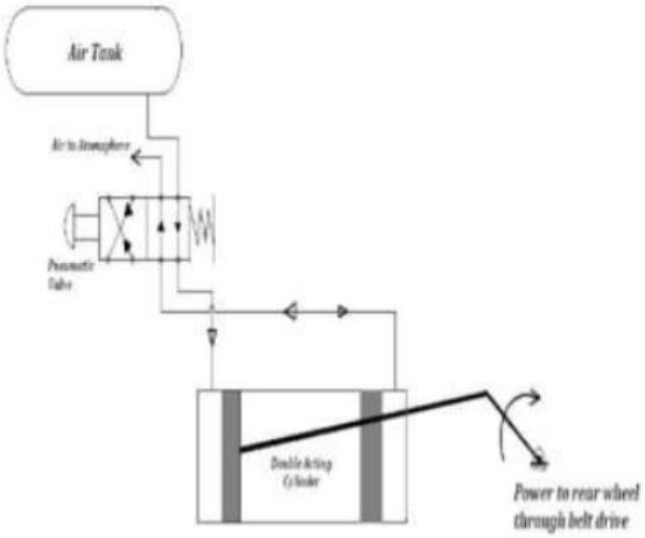
LIMITATIONS:

- ✓ Limited range
- ✓ Limited power output
- ✓ Complexity in controls
- ✓ Weight and size constraints
- ✓ Complexity in infrastructure integration
- ✓ Noise and vibration
- ✓ Limited market availablility

DESIGN:

1. **CAD MODEL:**

2. **FLOW DIAGRAM:**



COMPONENTS:

1) Air Tank:

In a pneumatic-powered bicycle, the air tank is used to store compressed air, which is the primary energy source for propulsion.

It provides power to the pneumatic motor or actuator, driving the bicycle forward. The air tank can also serve as a backup power supply and may incorporate features for adjusting pressure and monitoring air levels.

Overall, the air tank is essential for efficient and environmentally friendly transportation in pneumatic-powered bicycles.

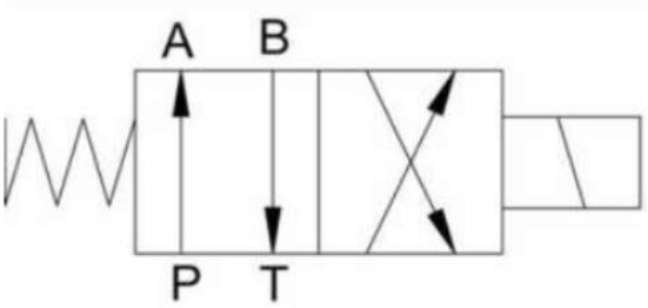
2) Pneumatic Pipe:

In a pneumatic-powered bicycle, pneumatic pipes are used to transport compressed air from the air tank to the pneumatic motor or actuator, which drives the bicycle forward.

These pipes provide a pathway for the pressurized air to flow, delivering power to the propulsion system.

Pneumatic pipes are essential components that enable the transfer of energy within the bicycle's pneumatic system, facilitating efficient and controlled propulsion.

3) Pneumatic DC Valve:

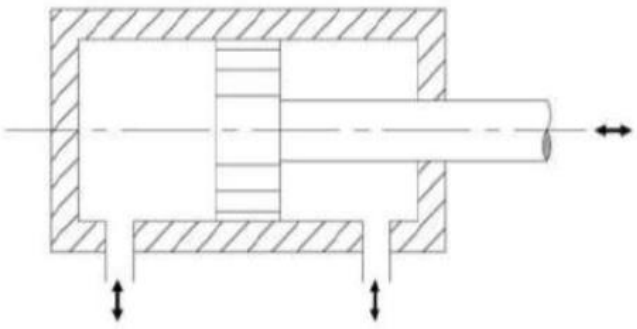


In a pneumatic-powered bicycle, a pneumatic DC valve is used to control the flow of compressed air from the air tank to the pneumatic motor or actuator.

It regulates the direction, speed, and pressure of the airflow, enabling precise control over the bicycle's propulsion system.

The pneumatic DC valve plays a crucial role in adjusting the power output and performance of the bicycle, contributing to smooth acceleration, efficient operation, and enhanced rider control.

4) Pneumatic Cylinder:

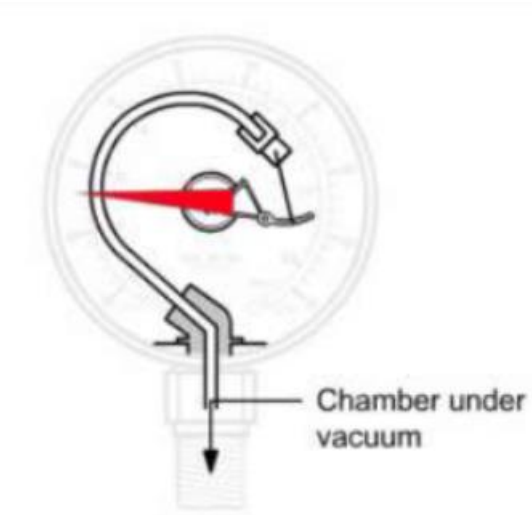


In a pneumatic-powered bicycle, a pneumatic cylinder is used as the actuator to convert the compressed air's energy into mechanical motion.

It pushes or pulls a component of the bicycle, such as the pedals or wheels, to propel the bicycle forward.

The pneumatic cylinder is controlled expansion and contraction drive the desired movement, providing efficient and responsive propulsion for the bicycle.

5) Pressure Gauge:



In a pneumatic-powered bicycle, a pressure gauge is used to measure the air pressure inside the air tank.

This allows the rider to monitor the remaining compressed air level, ensuring optimal performance and safety.

The pressure gauge provides valuable feedback to the user, enabling them to gauge the available energy capacity and plan their rides accordingly.

6) Pneumatic Safety Valve:

In a pneumatic-powered bicycle, a pneumatic safety valve serves as a crucial safety feature to prevent over pressurization of the air tank.

If the pressure inside the tank exceeds a predetermined threshold, the safety valve automatically releases excess air, preventing potential damage to the tank and ensuring safe operation of the bicycle.

This helps mitigate the risk of accidents or equipment failure due to excessive pressure buildup, enhancing overall rider safety.

7) Pneumatic Solenoid Valve:

In a pneumatic-powered bicycle, a pneumatic solenoid valve controls the flow of compressed air from the air tank to the pneumatic motor or actuator.

When energized, the solenoid valve opens, allowing air to flow and power the propulsion system. When de-energized, the valve closes, halting the airflow and stopping the bicycle.

This precise control mechanism enables efficient and responsive operation of the pneumatic-powered bicycle, enhancing rider control and safety.

CONCLUSION:

The pneumatic-powered bicycle project represents an innovative approach to sustainable transportation, harnessing the power of compressed air for efficient and environmentally friendly propulsion. Throughout this project, we have explored the design, implementation, and evaluation of a pneumatic-powered bicycle prototype, aiming to demonstrate its feasibility and performance characteristics.

By integrating pneumatic components such as air tanks, pneumatic motors or actuators, control systems, and safety features, we have developed a functional prototype capable of providing clean and quiet propulsion. Through comprehensive testing and evaluation, we have assessed key performance metrics such as speed, acceleration, range, and energy efficiency.

While the pneumatic-powered bicycle project offers several advantages, including zero emissions, low operating costs, and ease of maintenance, it also presents challenges such as limited range, energy efficiency, and infrastructure requirements. Addressing these limitations will require ongoing research, innovation, and collaboration to optimize performance, reliability, and usability.

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