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Development of Cost-Effective Air Jack

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ABSTRACT: This paper focuses on the use of air jacks in automotive maintenance and repair is extremely important to safely and efficiently lift vehicles off the ground. However, traditional air jacks are expensive and may not be accessible to many people, especially in resource-constrained environments. The purpose of this research is to study the development of a low-cost air jack that reduces manufacturing and operating costs while maintaining key features of previous models. This study presents a novel approach to design and manufacture affordable air jacks without compromising safety, performance and reliability through analysis of existing designs, materials and manufacturing techniques.

I. INTRODUCTION

1. Air Jack:

- Jack is a type of mechanical apparatus utilized for elevating substantial loads or exerting significant amounts of force. It operates by utilizing a square thread mechanism to raise weighty equipment. The typical variations include car jacks, floor jacks, or garage jacks, which are specifically designed to hoist vehicles for maintenance purposes. Mechanical jacks are typically assigned a maximum weight-bearing capacity, such as 1.5 to 3 tons. In cases where higher lifting power is required, more robust jacks employ hydraulic systems to achieve greater elevation.
- A vehicle-raising air jack consists of an exercise ball, a hose component that connects the vehicle's exhaust system to the exercise ball, and a solenoid valve that prevents the release of exhaust gases from the ball once it is inflated. This jack utilizes the pressure of the exhaust air to elevate the vehicle above the ground level.
- A conventional vehicle jack utilizes a screw thread arrangement to minimize the amount of force required for lifting heavy vehicles. However, instead of relying on human strength to operate the jack, an alternative approach employs the pressure of exhaust gas. This is achieved by directing the gas through pipes and fittings into an inflatable exercise ball, effectively harnessing the exhaust gas pressure to perform useful work rather than allowing it to dissipate into the atmosphere.
- During the production of this jack, it is crucial to prioritize minimizing its cost. To achieve this, utilizing affordable everyday items such as an exercise ball, waste sink pipe, and similar materials becomes essential. By incorporating these cost-effective components, the overall expenditure on the working parts can be kept at a minimum level.



2. Background and field of the invention:

The current invention pertains to an air jack designed for integration with a vehicle's exhaust system, specifically an air jack incorporating an inflatable member, also known as an air bag. This air bag can be inflated and expanded by

introducing exhaust gas into its interior. The air jack in question offers the flexibility to elevate any desired section of the vehicle, facilitating tasks such as tire repairs, maintenance work on the undercarriage, general vehicle maintenance, and similar purposes.

Currently available vehicle jacks are typically constructed from steel and require manual operation through gear systems, pneumatic systems, and similar mechanisms. These jacks can be exceptionally challenging to use, especially for individuals such as women, young adults, or individuals with limited strength. Moreover, due to the weight of certain metal jacks, it becomes inconvenient and arduous to employ them for lifting a vehicle body to change a flat tire. These difficulties are further compounded in adverse weather conditions like rain or snow, as well as on uneven surfaces, making it cumbersome to stabilize the jack to prevent the vehicle from slipping off while raised.

Lifting devices have undergone several advancements and innovations, leading to significant improvements in their functionality. The following developments have played a crucial role in enhancing lifting mechanisms:

- i. Levers: The utilization of levers has revolutionized lifting devices by providing mechanical advantage. Levers employ a pivoting action to amplify force and enable the lifting of heavy objects with reduced effort.
- ii. Screw threads: The integration of screw threads in lifting mechanisms has proven to be highly effective. By converting rotational motion into linear motion, screw threads allow for controlled and precise lifting operations. This advancement has been instrumental in applications requiring fine adjustments and stability.
- iii. Gears: Gears have been instrumental in the development of lifting devices, particularly in systems that require the transmission of force and motion. They provide mechanical advantage, enabling the lifting of heavy loads while ensuring smooth and efficient operation.
- iv. Wheels and axles: The incorporation of wheels and axles in lifting devices has facilitated the transportation of heavy objects with ease. By reducing friction and providing mobility, wheels and axles have improved the versatility and maneuverability of lifting equipment.
- v. Hydraulics: Hydraulic systems have brought about a significant transformation in lifting technology. By utilizing fluid power, hydraulic lifting devices are capable of generating immense force with minimal effort. This development has resulted in the ability to lift heavy loads with precision and control.

These various advancements in lifting devices have expanded their capabilities, making them more efficient, versatile, and user-friendly. The continuous improvement and integration of these technologies have revolutionized the field of lifting, enabling safer and more effective lifting operations across numerous industries.

II. RELATED WORK

- i. Title of Paper: Structural Analysis of Non-Return Control Valve using Finite Element Analysis [1]
Author Name: K. G. Saravanan (April 2015)
Summary: A non-return valve serves the purpose of ensuring that fluid flows through a pipe in the intended direction and prevents any reversed flow due to pressure boundary conditions. Its primary function is to allow the fluid medium to pass through in one direction only. However, it is important to note that the presence of a non-return valve in the system can result in a relatively significant pressure drop as the fluid flows through it. This pressure drop must be taken into consideration during the design of the system.
- ii. Title Of Paper: Vehicle Mounted Pneumatic Car Jack. [2]
Author Name: Faizan Nasir (2009)
Summary: The Vehicle Mounted Pneumatic Jack was developed by prioritizing customer requirements and engineering features to ensure that the design meets the needs of the customers. This customer-centric approach proved to be successful in creating an effective product. The pneumatic jack underwent a critical load-test as part of its evaluation process. After passing the air-leak test, the jack was placed under a test vehicle and additional weights were added to simulate a design load of 2000 lbs. The air compressor was activated, raising the vehicle to its maximum achievable height using the airbag. At the designated pressure of 100 psi, the distance between the raised wheels and the ground was carefully measured and recorded.
Once the desired maximum height was reached, the air compressor was turned off, and the vehicle remained raised for a period of 2 hours. After the 2-hour duration, the distance between the raised wheels and the ground was measured again and compared to the initial readings. The results showed that there was no significant change in the height of the wheels from the ground, indicating the successful completion of the load test for the pneumatic jack system.

This outcome demonstrated the system's capability to effectively lift the vehicle and maintain stability under the specified load conditions. The pneumatic jack proved to be a reliable and durable solution, providing the necessary support for vehicles during maintenance and repair operations.

- iii. Title Of Paper: Development and Evaluation of an Air Operated Vehicle Jack. [3]
Author Name: Benjamin Mathews, M. A. Murtaza (May 2016).
Summary: The focus of this project was to minimize costs and ensure the feasibility of an exhaust air operated vehicle jack without compromising performance and efficiency. An exercise ball, commonly referred to as a Swiss Ball, was utilized due to its versatility and adjustable air pressure. With a diameter ranging from approximately 35 to 85 centimetres (14 to 34 inches) and the ability to withstand a significant weight capacity of around 200-250 kg, the exercise ball served as a suitable component for the project.
By utilizing the exhaust air from the vehicle, this innovative jack design eliminates the need for manual labor involved in positioning the jack beneath specific jacking points and physically lifting the vehicle. This streamlines the process and reduces the physical strain associated with traditional jacks. Furthermore, the project holds potential for further enhancements and adaptations to accommodate diverse requirements, including the capability to handle heavier loads.
Throughout the development and evaluation phases, a key objective was to strike a balance between cost-effectiveness and performance optimization. By achieving this balance, the project aimed to create a practical and efficient solution for lifting vehicles, while minimizing associated expenses. The successful implementation of this exhaust air operated vehicle jack offers promising prospects for enhancing lifting mechanisms and advancing the field of automotive maintenance.
- iv. Title Of Paper: Design and Development of Integrated Pneumatic Car Jack. [4]
Author Name: Kaushal H. Pandya
Summary: When a car experiences a puncture or breakdown, it becomes necessary to raise it to a certain height for repair or maintenance. Currently, the common method employed for lifting the vehicle involves the use of a hand-operated screw jack provided by the vehicle manufacturer. This process entails removing the jack from the vehicle, positioning it correctly under the axle, and manually rotating the screw to initiate the lifting action. The concept of utilizing a screw as a mechanical device, essentially an inclined plane wrapped around a cylinder, dates back to Archimedes in 200 BC, who famously employed a screw mechanism for water pumping purposes.
- v. Title of Paper: Design and Analysis of Pneumatic Bag Air Jack. [5]
Author Name: Timur Choban Khidir (January 2019)
Summary: Drivers require a lifting device, such as a jack, that is specifically designed to fit securely under a vehicle and in the correct position for changing tires. In workshops and maintenance centers, jacks are essential for tasks such as maintenance and refurbishment of vehicle parts. The introduction of these devices has significantly improved the efficiency and ease of performing these tasks. Traditional car jacks typically rely on mechanical mechanisms, such as screw threads or hydraulic power, to enable manual lifting of the vehicle. Another option for lifting cars is the use of pneumatic air bags, which have proven to be highly effective in industrial, maintenance, and construction applications. To explore the advancements in this modern technology and develop a well-designed air bag capable of lifting and supporting the weight of vehicles weighing over 1200 kg, the study utilized SolidWorks software. This software allowed for the analysis of potential weak points in the pneumatic airbag design, ensuring that the final product meets the required standards of performance and reliability.
- vi. Title of Paper: Investigating the Deformation Parameters of PVC Fitness Balls in Relation to the Height and Body Mass Index of the Users.[6] Author: Laviu Stelian Dusa, Cristian Trambitas (December 2017)
Summary: Plastic materials have found extensive application in various physical, kinetoprophylactic, and therapeutic activities, as well as in the production of equipment, devices, clothing, and accessories for exercise and sports facilities [1,2]. Fitness balls, commonly known as fitballs, are manufactured using 100% polyvinyl chloride (PVC) that is non-phthalate, ensuring safety and compliance with regulations. These fitballs possess anti-slip and anti-burst characteristics, making them reliable and durable during use. The material thickness of the fitballs plays a crucial role in providing variable strength and stability.
From a mechanical standpoint, fitballs are designed to exhibit similar properties to plastics, which include elasticity, stiffness, resistance against bursting, and tensile strength. These properties ensure that fitballs can withstand the applied forces and pressures encountered during exercise routines, providing users with a safe and effective fitness tool. The careful selection of PVC as the material for fitballs takes into account these essential

mechanical requirements, allowing individuals to engage in their fitness activities with confidence and peace of mind.

III. OBJECTIVE

- The objective of the present invention is to offer an air jack that utilizes the exhaust gas from a vehicle to inflate a flexible member, commonly known as an air bag. This inflated air bag can then be employed to lift the vehicle, providing an efficient and effective use of the exhaust gas for this purpose.
- Another objective of the present invention is to offer an air jack that, when inflated, exhibits a balloon-like shape and is supported on one side by multiple studs. These studs play a crucial role in preventing slipping when the air jack is inflated and supporting a load, enhancing the stability and safety of the jack.
- Another objective of the present invention is to offer an air jack equipped with a hose that features a cone-shaped adapter at one end. This adapter serves the purpose of facilitating easy connection with exhaust systems of vehicles that have exhaust pipes of varying diameters. Additionally, a check valve is incorporated into the hose to prevent any backflow from the expanded air bag when the vehicle is in a raised position.
- To release the gas from the expanded air bag, one can simply disconnect the hose at the entry point of the air bag. Another objective of the present invention is to offer an air jack that is designed for ease of operation and is lightweight. This feature ensures that the air jack can be easily carried by individuals such as women or young adults without any difficulty.

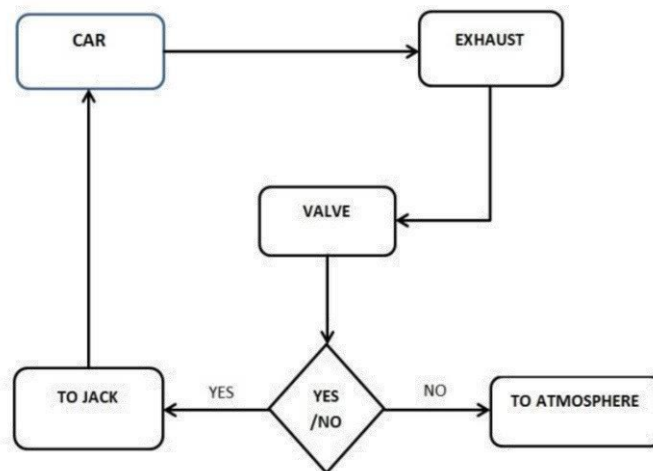
IV. METHODOLOGY

- Currently, the exhaust air operated jack utilizes the exhaust gases of a vehicle to inflate an exercise ball, which serves as a lifting mechanism to raise the vehicle for easy tire changing. The inflation process is achieved through pneumatic pipes that connect the exercise ball to the muffler tip, allowing the exhaust gases to flow into the ball. To prevent the backflow of exhaust gases, a solenoid valve is incorporated into the system.
- The lower portion of the air jack's balloon-like sack is safeguarded by a PVC coating, which provides protection against sharp objects such as stones or sticks that may be present underneath the vehicle. Manufacturers assure that there is no risk of pressure build-up in the engine as only a minimal amount of pressure is required to lift the car.
- Beyond roadside tire changes, exhaust air jacks have a range of practical applications. They can be used to lift either the front or rear tires, enabling the simultaneous installation of tire chains on two wheels. These automotive gadgets are also capable of lifting trailers, boat trailers, or any other vehicle with a frame and wheels.
- However, it is important to note that performing heavy work underneath a vehicle lifted on an exhaust jack is not recommended. The same caution applies to regular jacks as well. For such tasks, ramps or a sturdy floor jack are more suitable options. On the other hand, in emergency situations, having a portable lift like an air jack stored in the trunk proves to be highly convenient.
- When it comes to material and method selection, there is currently no established methodology available except for decision making in a multi-attribute environment. Material selection holds great significance in various industries today. Employing proper material selection techniques substantially reduces the risk of choosing the wrong materials or methods for a given application.
- In conclusion, the exhaust air operated jack offers a practical and efficient solution for lifting vehicles during tire changes. Its utilization of exhaust gases and the protective measures implemented ensure safe and effective lifting. With versatile applications beyond roadside emergencies, these jacks provide convenience for various tasks. However, it is essential to exercise caution and adhere to recommended safety guidelines when using any type of vehicle lifting device. Additionally, adopting appropriate material selection techniques plays a crucial role in achieving optimal performance and reducing potential risks.

Block Diagram:

The block diagram provides a fundamental understanding of the process where waste gases or exhaust gases from the muffler are utilized to inflate the exercise ball, enabling the lifting of the car. The flow of exhaust gases is designed to

be unidirectional, ensuring efficient and rapid inflation of the ball. To maintain this desired unidirectional flow, a solenoid valve is incorporated between the exercise ball and the connecting PU pipes. This solenoid valve is equipped with a manual or automatic override feature, allowing for control and adjustment as needed. By regulating the flow of exhaust gases through the valve, the inflation of the exercise ball can be precisely managed, ensuring the safe and effective lifting of the car.



V. CONCLUSION

During car repairs and maintenance, the task of lifting a car, whether it's to change a tire or perform maintenance work, is a common requirement. To address this need, various types of jacks have been developed. However, traditional manual jacks often demand significant effort and skill from the user. Additionally, these jacks are bulky, heavy, and challenging to position correctly beneath the car. In commercial settings, such as service stations and maintenance centres, larger and more robust car lifts are typically used.

For the purpose of lifting objects, including cars, object lifting jacks have been created. These jacks are versatile tools capable of pushing, pulling, lifting, lowering, and positioning loads ranging from a few kilograms to several tonnes. The automotive industry has long sought an improved portable jack that offers more convenience. Ideally, such a jack would allow for operation from inside the vehicle or from a safe location off the road. It should be lightweight and compact enough to be stored in a car trunk, easily carried and positioned by most adults, yet capable of lifting a wheel of a 25003000pound vehicle off the ground. Additionally, it should be easily manoeuvrable to position under the vehicle's axle or another reinforced support surface designed for jack engagement.

With these requirements in mind, a new product has been developed to meet the challenges of car lifting. This innovative "Air jack" combines design aesthetics, value addition, comfort engineering, high-grade materials, and a dedicated service team. While conventional jacks were widely used in the past, the air jack represents a significant advancement. It caters to different lifestyles and preferences, offering a sense of grandeur to car owners. The air jack has been meticulously designed and engineered to provide convenience and utility, making it highly desirable for car owners.

Introducing the air jack to the market addresses the growing need for a convenient lifting system. This system offers tremendous popularity potential, and entrepreneurs who embrace it can provide a highly sought-after facility for car owners. The air jack is not just a conventional jack; it stands out by incorporating unique concepts that allow for multiple purposes. This distinction sets it apart from other projects, as no other team has developed a single unit capable of serving various functions. Throughout the project, valuable knowledge was gained in terms of fabrication work, assembly processes, and material selection for specific components. Welding work was successfully implemented during the project's completion at our institute.

In summary, the development of the air jack addresses the limitations of traditional jacks by providing a convenient and efficient lifting solution for automotive vehicles. Its lightweight and compact design, coupled with its ability to lift heavy loads, make it a valuable asset for car owners. The combination of innovative design, high-grade materials, and a dedicated service team ensures the air jack's reliability and customer satisfaction. By introducing this ground-breaking product to the market, entrepreneurs have the opportunity to offer car owners an enhanced lifting experience that aligns

with their lifestyle and preferences. The air jack represents the culmination of extensive research and development efforts aimed at creating a cost-effective and highly functional solution for car lifting needs.

REFERENCES

- [1] K. G. Saravanan, "Structural Analysis of Non-Return Control Valve using Finite Element Analysis" April 2015.
- [2] Faizan Nasir, "Vehicle Mounted Pneumatic Car Jack" May 2009.
- [3] Benjamin Mathews, M. A. Murtaza, "Development and Evaluation of an Air Operated Vehicle Jack" May 2016.
- [4] Yuichi Katsura (2011) President of Nippon Basic Company "Japan Touts Pedal Powered Water Filtration" February 17, 2011.
- [5] Kaushal H. Pandya, Amit V. Sawant, Vinayak S. Gurav, "Design And Development Of Integrated Pneumatic Car Jack" February 2018.
- [6] Laviu Stelian Dusa, Cristian Trambitas, "Investigating the Deformation Parameters of PVC Fitness Balls in Relation to the Height and Body Mass Index of the Users" December 2017.
- [7] Hiromichi Nokazi, "Preferable front and Rear Weight Distribution of a Car" February 14, 2006.



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