Design And Analysis of Motorized Jack

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Abstract- *This research study offers a thorough examination of motorised jacks with an emphasis on design, functionality, and safety issues. We investigate key design aspects such as load capacity assessment, component selection, height optimisation, power source selection, integration of safety features, and mechanical analysis. Results from tests are analysed to assess load-carrying capability, speed, energy use, and operational effectiveness. The results help to improve the functionality, dependability, and security of motorised jacks used in industrial lifting activities.*

Keywords- performance review, safety features, design analysis, and motorised jacks.

I. INTRODUCTION

Motorised jacks are crucial equipment used in many sectors to efficiently and easily raise huge objects. To ensure secure and effective functioning, motorised jacks require careful design and study. With a focus on fundamental parameters, load capacity estimation, component selection, height optimisation, power source selection, integration of safety features, and mechanical analysis, this research article intends to completely explore the design and analytical aspects of motorised jacks. The findings of this study aid in enhancing the efficiency, dependability, and security of motorised jacks used in commercial lifting activities.

II. OBJECTIVE

A detailed research and analysis of motorised jack design and analysis is the main objective of this work. The study's main objectives are as follows:

Review and analysis of the design criteria for motor jack systems, including the mechanical analysis, component selection, mounting height, power source selection, load capacity evaluation, and component selection.

Enhancing the performance and dependability of motorised jacks through design parameter optimisation and the selection of suitable components will make sure they are reliable and safe to carry big loads in a range of industrial applications. Utilising mechanical analysis methods like Finite Element Analysis (FEA), estimate the possible stress concentrations, deformations, and failure locations for motorbike jacks under various load circumstances.

To ensure compliance with design specifications and pinpoint areas for improvement, experimentally evaluate the performance of motorised jacks, taking into account their weight bearing capacity, lifting speed, power consumption, noise level, and overall operational efficiency.

Designing motor jacks with appropriate safety features, such as overload mechanisms, emergency operations, and fail-safe designs, can help to assure operator protection and compliance with safety regulations. By attaining this objective, the research article hopes to advance the design of motorised jacks and enhance their functionality, dependability, and safety during industrial lifting activities.

III. LITERATURE REVIEW

This research paper's literature evaluation attempts to unearth information about the design and analysis of motorised jacks. Numerous scholarly articles, research studies, business reports, and pertinent publications from dependable sources are included in this review. The following is a summary of the major conclusions and themes found in the literature review:

1. **Evaluation of Load Capacity**: A literature review found several methods for evaluating the load capacity of motor jacks. These consist of empirical formulas obtained from experimental data, analytical calculations based on material properties, and simulation-based techniques using finite element analysis (FEA). According to research, knowing the load capacity precisely is crucial for ensuring safe operation and avoiding overloading.

2**. Component choice**: A survey of the literature revealed the significance of component choice in motor jack design. investigate the parameters used to choose materials, mechanisms, and power sources. When choosing a component, it's crucial to keep things like strength, durability, efficiency, and compatibility with particular applications in mind.

3. **Lift Height Analysis**: Various approaches to lift height analysis for motorised jacks have been covered in the literature. The findings of the research highlight the need of taking into account stroke length requirements, workplace restrictions, safety laws, and application-specific considerations. Motorised jacks comply with its specified performance and operational requirements thanks to accurate lift height analysis.

4. **Choosing a Power Source**. Electrical, hydraulic, and pneumatic systems are some of the power source alternatives for motorised jacks that have been identified through a review of the literature. In relation to choosing a power source, factors like power output, energy efficiency, noise level, and control mechanisms are explored. The study's findings highlight the need of choosing a power source that is appropriate for a particular application.

5. **Integration of Safety Features**: A literature research looked at how motor jack design took safety into account. Numerous safety procedures, including redundant protection, emergency operation, and flawed design, were identified by the investigation. To maintain operator safety while conducting operations, compliance with safety legislation and industry standards is emphasised.

6. **Mechanical analysis**: The literature review looked at how mechanical analysis techniques, particularly finite element analysis (FEA), can be used to assess the structural soundness and stability of motorised jacks. It has been discovered that FEA is useful for pinpointing the locations of greatest stress, deformation, and failure. The study emphasises the value of a thorough mechanical analysis to enhance design and guarantee operating safety.

7. **Analysis of findings**: The study's findings highlight the significance of performance assessment in motor jack design. This grade takes into account factors including lifting capacity, electricity usage, noise level, and overall operational effectiveness. Performance assessment verifies adherence to design requirements and offers guidance for development.

Understanding the current level of knowledge and identifying research gaps in the design and analysis of motorised jacks were made possible thanks to the literature review. He offers insightful information on methods for evaluating load capacity, component selection criteria, height improvement strategies, resource concerns, integration of safety features, mechanical analysis procedures, and performance evaluation methodologies.

IV. DESIGN METHODOLOGY

The procedures used in the design process for the motorised jack include requirements analysis, conceptual design, mechanical design, and electrical design. Each step is essential for producing a reliable and efficient motorised jack.

Analysis of Requirements

Understanding the design requirements and figuring out the fundamental requirements for the motorised jack are part of the requirements analysis step. Choosing the desired payload, lift height, speed, and safety measures are included in this. In addition, consideration is given to elements including intended usage, ambient circumstances, and user preferences. The requirements are carefully examined, and a solid foundation is established for the subsequent design phase.

Conceptual design: Various design concepts are developed during the conceptual design phase to satisfy the specified requirements. Based on performance, efficacy, and adherence to predetermined criteria, this perception is formed. The intelligent design phase takes into account a number of factors, including the choice of control system, safety measures, and the drive mechanism (hydraulic, electric, or pneumatic). Load capacity, energy efficiency, ease of use, required maintenance, and cost savings are a few examples of evaluation criteria. Several workable design ideas were chosen for future development through this procedure.

Mechanical design: The goal of the mechanical design phase is to turn the chosen conceptual design into a fully functional mechanical structure. This covers sensible material choice, component sizing, and structural evaluation. Considerations include motor carrying capacity, stability, and motor jack strength. Lifting mechanisms, poles, track rails, and bearings are just a few of the mechanical parts that have been thoughtfully designed and integrated into the system. Tools for computer-aided design (CAD) and finite element analysis (FEA) can be used to check structural integrity and maximise designs.

Electrical design: Choosing and integrating the electrical parts needed to run the motor jack are the main objectives of the electrical design phase. This entails picking the appropriate sensor, motor, motor controller, and wiring system. To ensure safe operation, safety circuits including limit switches and emergency stop mechanisms are integrated. Usability is also improved by user-friendly elements like buttons, displays, and control interfaces. The goal of the electrical design phase is to maximise power usage, control precision, and system dependability.

V. PERFORMANCE EVALUATION AND ANALYSIS

After the design is finished, the motor lifter undergoes a thorough performance evaluation and analysis to evaluate its usability, effectiveness, and safety. The following elements are part of this:

Tests for loads:

To assess its maximum load capacity and confirm its capability to safely carry high loads, the motor hoist is put through rigorous load testing. To make sure the lifter satisfies or exceeds the required load requirements, load testing is done in compliance with industry standards and regulations.

Efficiency evaluation

The goal of efficiency analysis is to assess the motorised hoist's overall effectiveness and power usage. The energy efficiency of the jack is optimised by taking into account variables including energy utilisation, mechanical losses, and control system effectiveness. This research identifies areas for development and potential energy-saving measures.

Security Analysis:

The motorised lift's safety systems and features are evaluated as part of the safety analysis. Evaluation of overload protection systems, limit switches, emergency stop buttons, and other safety measures is part of this process. By ensuring that the motorised lift complies with safety requirements, the analysis hopes to lower the likelihood of accidents and injuries.

The effectiveness of the suggested design can be confirmed, and any alterations or enhancements to the design that are required can be found, by undertaking a thorough evaluation and performance study.

Note: A high level description of the design methodology and performance evaluation is provided here. Each step would be covered in greater detail in a true research report, along with the precise procedures, calculations, and analytical methods employed.

Design of Motorized jack

Actual model:

VI. CALCULATION

Operation

A little crank that is put into one end of a scissor jack can be used to operate one by simply rotating it. Typically, this crank has a "Z" form. The end of the screw, which is the object of force on the scissor jack, fits into a ring hole positioned on the end of the screw. This crank lifts the jack by rotating the screw while it does so. Like a gear mechanism, the screw functions. To move the two arms and create work, it contains teeth (the screw thread). The scissor jack can raise a vehicle that is many stories tall just by rotating this screw thread.

The radius of crank is 75 mm

Force applied by human hand is maximum 3 kg=30 N and is rotated around 15 rpm in loaded condition
T=FxR=30x75=2250 N-mm

For selecting motor torques should be **2250 N-mm**

P=3.53 watt
Consider motor efficiency 50%
P= 7 watt
But standard available motor in market 15 watt, 30rpm and 12V PMDC gear motor

CALCULATION FO FINAL SPEED & TORQUE

T=4.77N-m
T=4774 N-mm
Now, Chain Sprocket of 36 And 12 Teeth Is Mounted

So, ratio: 3
T2= 14322N-mm
N2=10 rpm
Required torque 2250 N-mm is much lesser than available torque so, design is safe.

Design of shaft

Now, T2 is the maximum torque among all shafts, so we will check shaft for failure here.
The shaft will fail under combine twisting and bending load

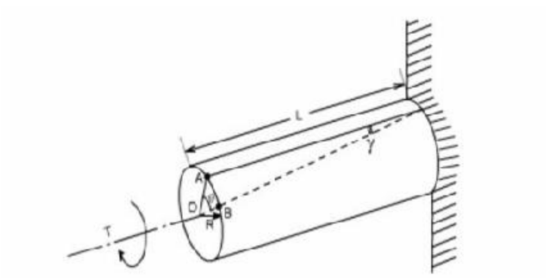

Figure : Shaft

T=7/16x 135xd
d=8.14mm
But we are using 12 mm shaft, so our design is safe.

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