Hydraulic Garbage Bin Lifter Mechanism: A Review

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***Abstract*—Research and development of a hydraulic garbage bin lifter aims to ensure a quick, safe, and smooth transition in garbage collection operations from small-scale trucks to an RC truck, which transports trash to dumping yards. Excessive time, manpower, and fuel are spent maintaining specific engine RPMs, which control the hydraulic systems. This results in wasted space as small dumper trucks are filled to capacity to load a single RC truck unnecessarily. The process includes designing and fabricating the model setup using CAD or Solidworks, conducting experiments, analyzing results, and drawing conclusions. Upon testing and obtaining results, the project's conclusion will be reached and implemented.**

***Indexed Terms*—Quick, Safe, Excessive Time, Hydraulics.**

I. INTRODUCTION

In the current scenario, small vehicles with a loading capacity of 2 tons operate within the city for garbage collection. These vehicles convene at a central point to unload their garbage into the RC truck (RC - Refuse Compactor). However, this process requires the RC truck to remain on standby mode while awaiting other small garbage collector vehicles to deposit their garbage. Consequently, this procedure consumes excessive time, manpower, and fuel, as the RC truck's engine must maintain a particular speed of RPM in neutral mode.

To address this issue, a specialized winch-operated wire rope mechanism will be designed, fabricated, and subjected to structural analysis. The project objectives are to design a specialized winch-operated wire rope mechanism with specific parameters for design, processing time, and cost-effectiveness. This mechanism aims to conserve fuel, reduce costs, minimize operating time, and decrease unnecessary manpower usage. The winch will be operated by the hydraulic systems already installed on the RC truck. Additionally, the mechanism will be powered by a worm and worm gear system.

II. LITERATURE REVIEW

A literature review serves to comprehend the prior research conducted in a particular field, encompassing findings from books, national and international journals, conference presentations, and postgraduate or doctoral research. This review is pivotal in the research process, providing researchers with a comprehensive understanding of the subject and guiding future endeavors toward defined objectives. Moreover, it furnishes crucial guidelines, aiding researchers in addressing their research problems.

Qinqfenq Huang, Yage Huang, Zhiwei Zhang, Yujie Zhang, Weiiian Mi, Chao Mi [1] designed a vision-based truck-lifting prevention system. This system uses a camera to detect and track the movement of the truck wheel hub during the operation to determine whether the truck chassis is being lifted. The accident detection algorithm combines convolutional neural network detection, traditional image processing, and a multitarget tracking algorithm to calculate the displacement and posture information of the truck during the operation. The experiments show that the measurement accuracy of this system reaches 52 mm, and it can effectively distinguish the trajectories of different wheel hubs, meeting the requirements for detecting lifting accidents.

Himanshu D. Raiyani, Kaushik A Devmurari, Prof. G. H. Upadhyay, Prof. U. V. Shah, Viiay Mistry [2], designed various components of Container Lifting Devices (CLD) model like a hydraulic cylinder, leaf spring, and hoisting chain, mechanical jack, cross-rod, etc. it's necessary to find out the performance of the device in dynamic software environment like ANSYS

workbench and based on obtained result find out whether the design is safe or not. The final result showed that the new design of the container lifting device is safe under maximum load conditions.

Shanzenq Liu and Lianiie Zhang [3], performed the kinematics and force analysis of the lifting mechanism of the detachable container garbage truck. the structural features and working mechanism of the detachable container garbage truck were presented. Then, for each working condition of the DCG truck, kinematic models were established, and the force analysis of the lifting mechanism was performed. Finally, the movement of a 20-ton DCG truck was calculated and analyzed as an example. Using a 20 T swing arm DCG truck as an example, the kinematics and force conditions of the lifting mechanism were calculated and analyzed.

Vitus M. Tabie, Yesuenyeaqbe A. K. Fiaqbe. Weight [4], suggested the optimization of a lift-tipping mechanism for a small solid waste collection truck. Finite element analysis was performed on a linkage mechanism that operates the tipping mechanism. The exercise involved validating the design changes made in the stress analysis environment. The workflow was repeated until the weight of the designs was optimized against the design criteria. Siemens Solid Edge ST3 software package, NX Nastran (7) solver was used in the optimization process. The weight of the linkage mechanism has been reduced from 11.6 kg to 7.5 kg which represents 35.4% reduction in weight.

III. PROPOSED METHODOLOGY

Designing the Mechanism: This stage involves creating the model of the mechanism intended for attachment or fabrication onto the existing hydraulic circuits aboard an RC-Truck (Refuse Compactor). Utilization of design software such as Computer-Aided Design (CAD) or SolidWorks is imperative.

Fabricating the Model Setup: This phase encompasses the fabrication of the model based on the CAD or SolidWorks design. Real-world stresses will be taken into account, facilitating testing to identify potential issues not accounted for in virtual analysis.

Conducting Experiments: The testing procedure will examine the compatibility of the fabricated model with the RC-Truck and gauge the performance of its components across different stress levels. This encompasses verifying compatibility, scrutinizing functionality, and assessing durability in diverse conditions. Ultimately, the objective is to ascertain that the model can effectively endure the challenges encountered during its operational use.

IV. WORKING PRINCIPLE

1. The development of a hydraulic garbage bin lifter entails the utilization of advanced hydraulic winch and pulley systems, strategically engineered to effortlessly elevate the garbage bin with precision and safety at the forefront. These sophisticated systems facilitate meticulous control over the movement of the wire rope, guaranteeing a seamless and controlled lifting operation.
2. Central to this innovation is the integration of the Power Take-Off (PTO) mechanism from the vehicle, which serves as the power source for operating the hydraulic winch with optimal efficiency. By harnessing the vehicle's power in this manner, the hydraulic garbage bin lifter ensures a swift, reliable, and energy-efficient solution for waste management operations.
3. Moreover, this integrated approach not only simplifies the lifting process but also enhances overall productivity and resource utilization. It eliminates the need for excessive time, manpower, and fuel traditionally expended in maintaining specific engine RPMs to control hydraulic systems, thus minimizing operational costs and environmental impact.
4. Furthermore, the hydraulic garbage bin lifter addresses the challenge of wasted space in small dumper trucks, which are often filled to capacity unnecessarily before transferring the trash to the RC truck. By enabling precise control over the lifting process, it optimizes the loading of garbage bins onto the RC truck, maximizing payload capacity and minimizing unnecessary trips to dumping yards.
5. The design and fabrication of the hydraulic garbage bin lifter involve meticulous planning and engineering using advanced software tools such as CAD or Solidworks. Through a systematic

approach of designing, testing, and refining the model setup, the project aims to achieve the desired objectives of efficiency, safety, and reliability in garbage collection operations.

6. Upon conducting experiments and analyzing results, the project will draw conclusions that inform further refinements or optimizations to the hydraulic garbage bin lifter design. Ultimately, the successful implementation of this innovative solution promises to revolutionize garbage collection operations, paving the way for a more sustainable and efficient waste management system.

V. COMPONENT

The fabrication of the mechanism will make use of components readily available in the market.

Components to be used in the fabrication are:

A. Hydraulic Motor [Gear Motor]: Gear motors are often used in hydraulic systems to provide controlled and precise rotational motion. They work by converting hydraulic energy into mechanical energy, allowing for the controlled movement of machinery or equipment.

B. Gear Box [Worm & Worm Wheel]: Worm and worm wheel gearboxes play a crucial role in hydraulic systems, serving to reduce speed and enhance torque output. Renowned for their ability to achieve significant gear reduction ratios while maintaining a compact design, these gearboxes are ideal for applications requiring slower output speeds and greater torque.

C. Pulley: Pulleys aren't commonly used directly in hydraulic systems. However, they can be part of systems that incorporate hydraulic components. In such cases, pulleys might be used for power transmission or to change the direction of force or movement.

D. Wire Rope: In certain specialized applications, wire ropes might be used alongside hydraulic systems for tasks that require both hydraulic force and mechanical pulling or lifting power. Wire ropes could be employed in conjunction with hydraulic winches or hoists.

E. Winch Drum: A winch drum in a hydraulic system serves as a spool around which a cable or rope can be wound or unwound. This component is employed to exert pulling or lifting forces in various applications. In hydraulic systems, a winch drum driven by a hydraulic motor can efficiently handle heavy loads.

F. Pedastal Bearings: Pedestal bearings in hydraulic systems function as support structures for rotating shafts, enabling smooth rotation under heavy loads. They offer stability and alignment, thereby reducing friction on the rotating shafts.

VI. RESULT, DISCUSSIONS AND CONCLUSION

- Analysis of test outcomes is conducted to identify areas requiring enhancement, rectify any failures, or make essential adjustments to the mechanism. Conclusions regarding the fabricated mechanism are drawn upon achieving the desired safety and operational standards, ensuring its effectiveness and reliability.

- The insights gleaned from the outcomes will serve as valuable resources for project stakeholders, facilitating informed decisions for future modifications and enhancements. These findings provide a foundation for ongoing improvement efforts, ensuring the project's continued development and success.
- Moreover, this system promotes the development of intelligent mechanisms that are both user-friendly and efficient. Such mechanisms aid in minimizing excessive fuel consumption, streamlining the garbage collection process, and optimizing space utilization.

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