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RESEARCH ARTICLE OPEN ACCESS

DEVELOPMENT OF AN EXTERNAL PUMP FOR OIL TRANSFER FOR MAINTENANCE OF TRUCK LIFTING PLATFORMS

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ABSTRACT

This work focuses on adapting an external oil transfer pump to improve the maintenance efficiency of truck lift platforms. The motivation behind this research arises from the need identified in the maintenance operations of these equipment, often faced with challenges in transferring and handling oil to the truck platform lifting system, resulting in unnecessary product losses and prolonged maintenance time. The main objective of this project is to adapt an external oil pump, which optimizes the maintenance process of truck lift platforms, saving time and reducing oil waste. To achieve this objective, the research explores different pump technologies available on the market, considering the advantages, disadvantages and costs involved. The methodology involves a study of the operation of lifting platforms and the difficulties faced in their maintenance. Finally, an external transfer system was designed and tested with the aim of evaluating its efficiency and functionality. It is believed that this work will not only optimize the maintenance process of truck lift platforms, but will also contribute to reducing oil waste, generating significant benefits in terms of saving resources and time in the daily maintenance operations of this equipment.

I. INTRODUCTION

The freight transportation industry has grown over the years, increasing the need for maintenance of truck lift platforms. Oil transfer during maintenance is time-consuming, expensive, prone to error and waste. The objective of this work is to adapt an external oil transfer pump capable of optimizing the maintenance process of truck lifting platforms.

The aim of the new pump is to reduce oil transfer time and minimize waste during maintenance of truck lift platforms. The central question of the research is how to select and adapt an external pump to the platform system capable of reducing oil waste and maintenance time. To answer this question, the research will include a literature review, the selection and adaptation of a pump available for use, followed by comparative testing of results under different operating conditions.

The main objective of this work is to adapt an oil pump, external to the platform's organic system, capable of optimizing the maintenance of truck lifting platforms. This proposal will be achieved by saving time when carrying out maintenance and minimizing oil waste during the process [1]. Therefore, the result is expected to be a significant improvement in the efficiency of the maintenance process.

The central research question is how to adapt an oil pump to improve efficiency in truck lift platform maintenance, involving an analysis of current processes to identify areas for improvement. The research seeks to contribute to mechanical engineering by offering low-cost equipment that has applicability in the current context and similar ones, increasing its relevance.

The proposal fits within mechanical engineering in the hydraulic systems discipline. Although there are several studies carried out to improve the efficiency and reliability of these systems, which is crucial to ensure the safety and effectiveness of

lifting operations [2]. The present study considers the difficulty of accessing the lifting system reservoir, which generates oil waste.

Maintenance of lifting platforms is a critical aspect of ensuring their safe and efficient operation. Failure to perform adequate maintenance can lead to unexpected and potentially dangerous downtime. The use of a suitable oil transfer pump can significantly facilitate maintenance operations, allowing a quick and clean fluid change [3].

Adapting an oil transfer pump to maintain truck lift platforms requires research into pumping systems available on the market. There are several types of pumps with specific advantages and disadvantages, the choice depends on the viscosity of the fluid, the operating conditions and the costs involved.

In short, choosing an oil transfer pump involves a series of important technical considerations. The literature review suggests that the appropriate choice of pump type, a robust and durable design, and energy efficiency are critical aspects to be considered.

Manufacturers seek improvements in pump efficiency, with many focusing on aspects such as compact form factor, ease of use, and ability to handle different types of oil [4]. Furthermore, technological advances have allowed the development of pumps with greater precision in controlling oil flow and pressure [5].

In the case of the present work, the issue related to pressure and oil characteristics are not a priority, as the objective is to build a simple oil transfer system to the truck's lifting system reservoir, bypassing the difficult access between the truck pump and lifting system and the system reservoir.

From the above, the adaptation of an external oil transfer pump for the maintenance of truck lifting platforms requires the application of hydraulic systems and the analysis of the operational needs and difficulties identified in the daily maintenance operation. The use of simple techniques can contribute to the creation of an efficient, reliable solution with an adequate cost-benefit ratio.

The general objective of the work is to adapt a simple and effective oil pump, capable of optimizing the maintenance process of truck lifting platforms. This aims to not only save time, but also minimize oil waste during operation.

II. METHODOLOGY

The methodology was carried out in three stages, starting with a broad literature review to identify best practices and existing technologies related to the development and operation of oil transfer pumps. This review will help identify which features are essential for an effective and efficient pump, as well as any potential gaps in current technology [6].

Then secondary research will be conducted to collect information on the types of pumps that are commonly used in the industry. This will include a study of the advantages and disadvantages of the types of pumps available on the market. Sources of this data may include manufacturer user manuals, technical reports, and published studies [7]. The table below shows a comparison between five types of pumps available on the market.

Table 1: Types and Characteristics and advantages and disadvantages of pumps.

PUMP TYPE	DESCRIPTION	ADVANTAGE	DISADVANTAGES	COST
Hydraulic Gear Pump	Gear pumps are used in the hydraulic systems of smaller truck lift platforms. They are compact, efficient and provide a continuous flow of hydraulic fluid.	Simplicity of construction and low cost. Good efficiency in medium pressure systems. Quiet operation compared to some other pumps. Suitable for low to medium pressure and flow applications.	Less efficient at high pressures. Faster gear wear at high speeds. Tendency to generate pulsations in the flow.	Low.
Axial Piston Hydraulic Pump	Axial piston pumps are often employed in lift platform systems for larger and heavier trucks. They are capable of generating higher pressures and are known for their efficiency and ability to deliver high power.	High efficiency over a wide range of pressures. High speed operation capability. Good dynamic response, suitable for systems requiring precise control.	Greater construction complexity. More demanding maintenance.	High.
Radial Piston Hydraulic Pump	Radial piston pumps are similar to axial piston pumps in terms of application, but have a slightly different design. They are used in lifting systems that require very high pressures and are known for their quick response capabilities.	High efficiency over a wide range of pressures. Good dynamic response. High speed operation capability.	Construction complexity. Requires more careful maintenance.	Moderate.
External Gear Hydraulic Pump	External gear pumps are suitable for medium-duty applications and offer a combination of performance and durability.	Simplicity of construction. Acceptable efficiency in medium pressure systems. Relatively silent operation.	Less efficient at high pressures. Tendency to generate pulsations in the flow.	Moderate.
Hydraulic Vane Pump	Vane pumps are compact and are often used in smaller truck lift systems and general lifting equipment.	Silent operation. Simplicity of construction. Suitable for low to medium pressure and flow applications.	Lower efficiency compared to some other pumps in high pressure systems. Vane wear requires periodic maintenance.	Moderate.

Source: Adapted from [8].

After collecting the secondary data, a tertiary survey will be carried out to collect information directly from the maintenance operators of these lifting platforms. This may involve interviews or questionnaires with mechanics, platform operators and maintenance managers. These individuals will be selected through a stratified random sample to ensure a wide range of experiences and perspectives are captured [9].

When considering that the exact quantification of problems faced by truck lift platform users can vary widely depending on context, platform type, location of use and other factors, data collection requires specific information, directing the response to an approximate representation of the severity of each issue based on a relative importance scale.

Therefore, specific information will be based on ten aspects: frequent maintenance and repairs; hydraulic leaks; excessive noise; complex maintenance; lack of adequate training; maintenance cost; difficulties in replacing oil, wastage of oil, and safety. The result of the simulation will provide relevant information about the percentage of participation of each aspect involved in equipment maintenance.

Finally, the results of the analysis were used in the development of the oil transfer system, which will be subjected to rigorous testing to ensure it meets the requirements identified in the research phase. The figure below shows the oil transfer scheme.

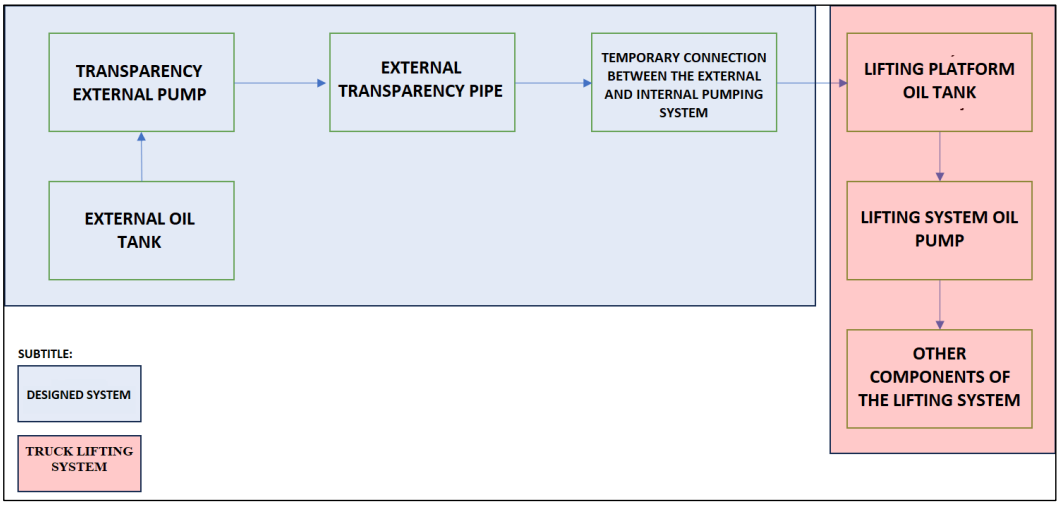

Figure 1: Schematic of the designed pumping system and its interconnection with the truck lifting system.
Source: Authors, (2023).

III. RESULTS AND DISCUSSION

The results of the development of an oil transfer system, with the aid of an external pump, in the maintenance operation of truck lifting platforms were very promising. The pump was successfully adapted and allowed the maintenance process to be optimized, making it more efficient, safe, faster and less expensive.

Research on the pump model to be used in the oil transmission process from the external reservoir to the lifting system reservoir indicated the Hydraulic Gear Pump as the most advantageous, due to its simplicity, operation at low flow pressure, ease of operation, low noise and, especially, low acquisition cost.

From the collection and analysis of data regarding the current maintenance process of lifting platforms, it was possible to conclude that the current process is time-consuming, potentially dangerous and expensive, considering the waste of oil generated by the manual process of insertion into the hydraulic system reservoir of the lifting platform. elevation. The figure below shows the results of the survey carried out with maintenance operators:

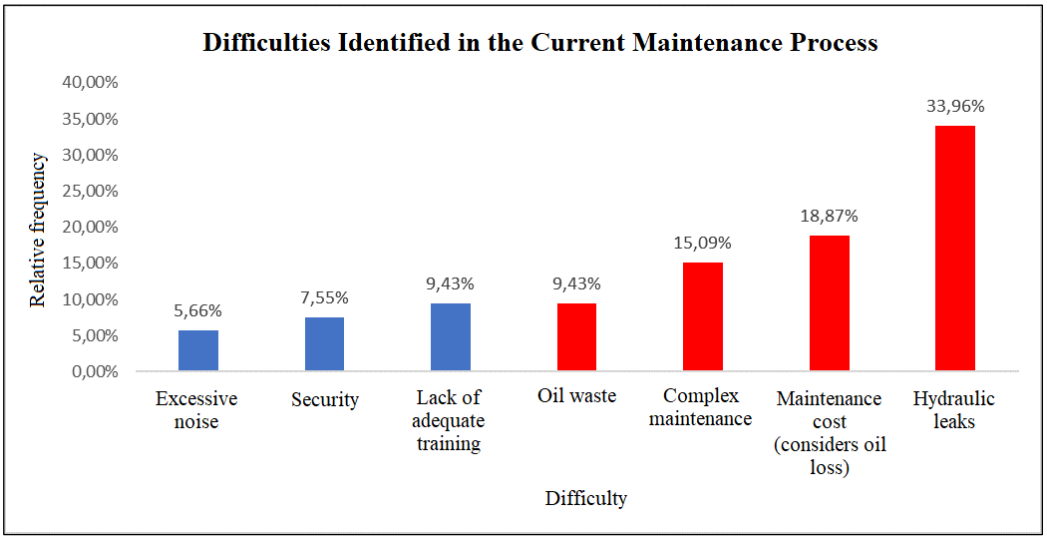

Figure 2: Difficulties identified in the current maintenance process.
Source: Authors, (2023).

Based on this information, the design of the oil transmission system for the lifting system showed the need to introduce an external pump with a focus on reducing oil waste and the complexity of the maintenance process. The chosen pump, due to its ability to pressurize, medium pressure, the oil transfer system, significantly reduced the time required for maintenance from forty minutes to fifteen minutes per truck.

As can be seen in the photo album attached to this work, in preliminary conclusion, the results indicate that the use of the pump in the transmission process from the external to the internal reservoir to the platform lifting system significantly improved the maintenance process of lifting platforms of trucks. However, as shown in the graph in figure 2, an increase in the training of maintenance personnel is necessary.

The photo album attached to the work details the test phases, where it was possible to observe that the new pump is capable of transferring oil in a time two and a half times longer than the manual transfer process previously used. This represents a significant reduction in the time required to maintain trucks. Furthermore, the new pump proved to be robust and resistant, with little or no need for maintenance throughout the test period.

Another important aspect observed during the tests was the fact that the new pump does not allow oil to spill during the transfer process from the primary reservoir to the truck platform lifting system reservoir, this promotes a safer and more efficient working environment. clean.

Regarding the cost-benefit regarding the installation of the pump, the results were equally positive, considering the cost of implementing the system and the savings related to reducing oil waste in the transfer operation. The introduction of the additional pump provided a cost-benefit ratio $\frac{C}{B} = \frac{Benefício\ Líquido}{Custo\ total} = \frac{15000}{500} = \frac{30}{1}$), which means for an investment of 500 reais it provided savings, resulting from the reduction of oil waste, of 15,000 thousand reais.

The results obtained after implementing the external pump for oil transfer indicated a significant improvement in the efficiency and safety of the process, resulting from the reduction in maintenance time and the complexity of the operation.

The development of the oil transfer process for the truck platform lifting system is in line with the literature review on the subject. According to [10], efficiency in preventive maintenance is crucial to ensuring operational reliability and safety in maintenance operations. In the specific case of truck lifting platforms, maintenance procedures involve frequent oil replacement, a process that can be time-consuming, complex and costly if carried out using manual processes.

The pump used in this project incorporated features that improved both the safety and efficiency of the process. According to [11], the innovative use of technology can substantially improve preventive maintenance procedures. In this context, the use of an external pump represents a significant contribution to the field. The implications of these results are important from both a practical and theoretical point of view.

In practice, the incorporation of an external pump in daily operations resulted in significant savings in time and human resources, in addition to reducing potential risks associated with inadequate oil handling. Theoretically, these results reinforce existing literature that emphasizes the importance of innovation in preventive maintenance [10] and [12].

The reviewed literature and preliminary research into the development of an external system, with the introduction of a pump, demonstrated the need for innovations in this specific field, in line with the studies carried out by [13] showing that the time spent maintaining lifting platforms is one of the biggest challenges faced by companies in the sector. In this sense, the results obtained in this work confirm the hypothesis proposed by the authors, indicating that the use of an external pump can be a viable and efficient solution to this problem.

Another relevant point concerns sustainability. According to [14] and [15], the need for more sustainable practices in industry and society is urgent. In this context, the work presented reduced oil waste compared to traditional methods, thus contributing to a lower environmental impact.

According to the results obtained, it was clear that the development of this work provided a significant improvement in the maintenance of Truck Lifting Platforms. This aligns with existing literature on the topic, which suggests that the operational efficiency of this equipment is highly dependent on regular and adequate maintenance [16] and [17].

From all the above, the importance of the results presented in the present work lies in their application in maintenance practice, considering the high costs associated with mechanical failures, idle time during maintenance, oil waste and the complexity of the oil transfer operation. oil indicate that any improvements in these areas could lead to significant savings.

Thus, the development of a process for transferring oil from an external reservoir to the internal reservoir of the platform lifting system, using a low-cost pump, presents valuable potential to improve the general operational performance and profitability of companies that carry out maintenance services, as well as those that use trucks with lifting platforms.

IV. CONCLUSION

Throughout the research it was possible to employ an external pump that allows the transfer of oil to the internal lifting system of the truck platform during the maintenance operation, which played a crucial role in efficiency, simplification of the operation, safety of the maintenance team and reduction of oil waste.

The results obtained show that the external pump significantly increases the speed and accuracy of oil transfer, reducing the time required for maintenance, minimizing the risk of human errors and oil waste. Furthermore, the pump also allows the reduction of environmental impacts resulting from oil spills.

In practical terms, these advantages imply lower operating costs, greater safety for workers and an adequate cost-benefit ratio. It is also important to note that the external pump is part of an external system that is easily adaptable to different types of lifting platforms, making it a versatile solution for different situations.

Therefore, the results of this work imply important advances, both from a technical and economic point of view. The use of the external pump represents an important step towards improving maintenance operations on truck lifting platforms, contributing to making this activity safer, simpler and more efficient.

The external pump proved capable of transferring the oil in two and a half times less time than the manual method previously used. This means considerable savings in time and human resources. Furthermore, the pump showed a very low failure rate during tests, which suggests greater durability and reliability for the system.

It is important to highlight that the improvement in efficiency did not compromise the safety of operators, on the contrary, by reducing the complexity of the operation, it added

safety for maintenance personnel. Therefore, it can be said that the introduction of the external pump represents a significant advance in the area of lifting platform maintenance.

In short, the introduction of this pump has important implications not only for companies that operate lifting platforms, but also for maintenance service providers. Savings in time and human resources can be used in other areas of the company, increasing its competitiveness in the market [18]. Furthermore, the lower complexity in the maintenance operation provides agility and simplicity to the service, potentially mitigating workplace accidents, a benefit that extends to workers and society in general [19].

However, aspects were observed that could promote the improvement of the developed system, especially related to the external reservoir and the addition of a device for measuring the level of the lifting system reservoir, when transferring the oil.

V. AUTHORS' CONTRIBUTION

Conceptualization: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira and Douglas Pereira de Souza.
Methodology: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira and Douglas Pereira de Souza.
Investigation: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira and Douglas Pereira de Souza.
Discussion of results: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira and Douglas Pereira de Souza.
Writing –Original Draft: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira, Douglas Pereira de Souza and Marcus Renato Pinheiro Mattos.
Writing –Review and Editing: Marcus Renato Pinheiro Mattos.
Resources: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira and Douglas Pereira de Souza.
Supervision: Marcus Renato Pinheiro Mattos.
Approval of the final text: Anderson Bittencourt Gimack, Antônio Clisma Dantas de Oliveira, Douglas Pereira de Souza and Marcus Renato Pinheiro Mattos.

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