

# MODIFICATIONS OF THE CAR JACK TO A PIPE GRIPPER WITH RUBBERIZED STRIPS IN THE UPPER AND LOWER JAWS.

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## ABSTRACT

Handling of medium sized diameter carbon steel pipes ranging 6 inches to 8 inches is process that should to be done in the shortest possible time with the least amount of time and manpower. The present pipe handling process from a metal rack are not safety compliances, inefficient, unsafe, and time consuming, therefore there is need of proper gripping method to ensure safety, quick and efficient handling of carbon steel pipes before being transported to other location. An internal expanding parallel bar jaw gripper was developed having the same working principles as a typical car jack. The pipe intended to be transported will be internally inserted with the modified car jack at the end section of the pipe. The top fixed and bottom moving jaw of the jack which acts as the gripper has been layered by layer of reinforced rubber linings to increase gripping capacities that will not loosen even if there is high force being imposed in the jaws. The gripper system is quick in action and provides safe gripping. Safe gripping means that once the gripping force exceeds the effort being applied in the gripping process. The significance and objectives modification of this car jack is to test and evaluate the performance of this gripping jaws as to the minimum and maximum pipe size to be clamped internally, maximum time taken in gripping, de-gripping and the gripping safety factor force values, reduce health risk. The modified car jack is easy to use and will save time to operate. The design when fully utilized and used will effectively solve problems in pulling pipes from a metal rack safely and associating in Ergonomics being one of the concept values in designing the modified car jack.

Key Words: Jaw Gripper, Parallel Moving Jaws, Reinforced Rubber strips, Car Jack

## 1. INTRODUCTION

Materials “Handling” is defined in Compton’s Interactive Encyclopaedia as “The movement of raw materials, semi-finished goods, and finished articles through various stages of production and warehousing is called materials handling.” Material Handling is concerned with the movement, storage, and control of materials in a (production) process. Material Handling and logistics are expensive operations, which comprise about 10% to 80% of the product cost and this percentage tends to rise for inexpensive or commodity products. Physical distribution alone, i.e., the movement of products from the manufacturing plants to the customers, accounts for 25% of the product cost. Internal to the plants, more than 90% of the product flow time in a job shop is spent in material handling functions including waiting for an available machine.

A scissor lift (jack) or mechanism is device used to extend or position a platform by mechanical means. The terms "Scissor" comes from the mechanism utilized which is configured with linked, folding supports in a crisscross 'X' pattern. The extension or displacement motion is achieved applying of force to one of the supports resulting and an elongation of the crossing pattern. The force applied to extend the scissor mechanism may be hydraulic, pneumatic or mechanical (via a lead screw or rack and pinion system).

For a “scissor type jack” that has straight, equal-length arms, i.e. the distance from the horizontal-jack-screw attachment (or horizontal manua-ram attachment) point to the scissors-joint is the same as the distance from that scissor-joint to the top load platform attachment.

Having considered the best available tool to proceed with the modifications, the car jack has been chosen to act as an internal gripper. A gripper is a device which enables the holding or gripping of an object at all sides or partially to be manipulated. A gripper enables holding, tightening, handling and

releasing of an object. A gripper is just one component of many gripping system and to incorporate with the applications of the gripper a customized trolley has been built to assist with the gripping and pulling system.

## **2. LITERATURE REVIEW**

### **2.1 Introduction**

The scope of the study focuses on how the project is developed, which is through a reference source for information related. Among the methods for obtaining information are as follows:

### **2.2 Concepts**

A new and creative idea usually comes from holistic or critical observation to get a new product to create something with the new goal of facilitating work and time, saving time, energy and most importantly avoiding waste of energy, time and cost. At the same time product quality should be at a higher level and safe from existing products. The selected factors are as easy to handle, cost-saving, work-saving, systematic handling and simple but attractive and effective design

Grippers normally grasp or holds work pieces but it could also be modified to perform internal gripping by enhancing its basic working principles. A gripper should not be heavy but be as light as possible, but at the same time be able to accommodate its maximum gripping load and the weight of the pipe. The gripper should be fixed as close to the end of pipe as possible, so as to avoid high stresses on the gripper.. For cost- effectiveness, the gripper was a modification of a car jack, easy to maintain, reliable and safe. The basic working principles of a gripper is opening or closing its gripper jaws and they have their own specific functions. They have got many specific functions such as Parallel and Scissors-like motion

Therefore, as a result of the observations, a modification of a car jack using the parallel scissor motion is the most suitable. It is much simpler and has a strong gripping capabilities using a reinforced rubber strips

#### **2.2.1 Selection Of Concepts**

The selection criteria of this design are determined based on the existing "Car Jack" specification with the predefined features such as, Cost of manufacture is low, Reducing maintenance costs, Safety features, Process fabrication and installation and Greater capacity and effectiveness. Once all the criteria are identified, the idea that is in line with the Puller Pipe design has been selected. Assessment is based on the appropriate specifications and will meet the needs of users.

### **2.3 Design Selection**

For fabrication process it is important to consider certain modifications and tolerances in giving the pipe gripper with compliance which will allow some inaccuracies in the modification shapes and dimensions of components. Passive actions means, parts of the gripper that moves easily according to the assembly. Active actions may requires other devices to manipulate the efficiency of the gripping process.

During operations the gripper is used to grip the internal end section of the pipe. This pipe movement generates dynamic forces at the gripper against the internal wall diameter of the pipe as the parallel bars of the gripper accelerates vertically. Excessive Inertial forces can lead to damage of the rubber strips, so an exact design of the gripper and device must be checked against this very seriously.

#### **2.3.1 Design Methods**

This chapter also deals with the design of the gripping system itself. It consists of a modified car jack with the ability to act as a gripper being fabricated separately. The gripper corresponds to a ratchet for the pulling system which will be mounted on the end section of a designated trolley Functions of the parts mentioned above will be imposed in the system.

### 2.3.2 Concept

To redesign and built a puller using an actual Car Jack. Having the capability to extend its parallel bars vertically, this concept and will be used in redesigning its working principle.

### 2.3.3. Performance

The performance of a design should be known or determined such as speed, frequency of usage and load type. However, these values that are the final targets and specifications may change according to conditions. This situation is also sometimes associated with additional costs in the event of a change in the original design.

### 2.3.4 Costs

The cost of a product is bearable since it is only a typical car jack.

### 2.4 Previous Study

Intensive studies and observation are basically done on a typical car jack. Focusing in its working principles.

### 2.5 Equipment Review

Studies have also been carried out by taking some examples of real equipment that has the capabilities of lifting or gripping features.



**Figure 1:** Types of external grippers and a unmodified Car Jack

**Table1:** Shows the difference in pulling API steel pipe / ASTM Schedule 40 NPS 6 "from the material rack.

	<b>Pulling pipes manually using manpower</b>	<b>Pulling pipe using The Pipe Gripper with the aid of a ratchet</b>
<b>Figure</b>		
<b>Problems</b>	Lack of safety and unergonomic	Safe, less time in handling and more ergonomic

## 3.0 METHODOLOGY

### 3.1 Introduction

The project implementation will be explained from the planning stage until the Pipe Gripper is completed. To illustrate the method of implementation of this project more clearly, diagrams, tables and drawings will be shown. Basic analysis directly related to Pipe Gripper will be shown.

#### 3.1.1 Design research

Design on project will be discussed and determined thoroughly before conforming on the final design. Types of the materials used should be noted.

#### 3.1.2 Design Concepts

Applying the basic movement and working principles of a car jack with its permanent lower and upper jaws. Introducing rubberized material to accommodate anti slipping and better gripping mechanism.

#### 3.1.3 Fabrication Process

Gas Metal Arc Welding ( GMAW ) process will be used throughout the fabrication process. Reinforced rubber strips will be used because of its reinforcing material, high strength to flexibility and better compression can be achieved. The reinforcing material, usually a kind of fibre, provides the strength and stiffness. The rubber matrix, with low strength and stiffness, provides air-fluid tightness and supports the reinforcing materials to maintain their relative positions. These positions are of great importance because they influence the resulting mechanical properties.



**Figure 2:** Reinforced rubber strip

### 3.2 Pulling Process

In assisting the pipe gripper a ratchet consists of a round gear (see Figure 3) or linear rack with teeth, and a pivoting, spring-loaded finger called a *pawl* that engages the teeth will be used to act as the pulling mechanism strongly because of its asymmetrical, teeth with each tooth having a moderate slope on one edge and a much steeper slope on the other edge.



**Figure 3:** The Ratchet used in pulling the pipe.

**Table 2.** Check-list for gripper design and selection

Factor	Consideration
Material handling	weight and size physical changes of components during fabrication redesigning and modifications components surface conditions
Material movement	Mechanical gripping and pulling
Transporting	mechanical
Gripper force (mechanical gripper)	weight of pipe method of coefficient of friction between clamping jaws and object speed versus time in handling
Jaw positioning	Size of jaws repeatable usage of gripper
Service conditions	replacement of worn rubber strips Low cost maintenance and service charges.
Operating conditions	Easy access and free space movement
Fabrication materials	weldable, lightweight low cost and simple fabrication process
Corresponding mechanism	Readily to mounted on trollies
Future enhancement	Using 4 clamping jaws

### 3.3 Gripper Analysis

A comprehensive analysis was carried out. Earlier detail data collection base on questionnaires will not be mention in this chapter but the summarization will be shown.

**Table 3:** Distance vs Time for gripping movement

Screw jack rotation	Distance (cm)	Time (sec.)
0	13	0
1	13.7	7.3
2	14.3	8.9
3	14.9	10.5
4	15.19	12.25

**Table 4:** Selection of design

Factors	Design 1	Design 2
Cost	2	6
Gripping stability	3	10
Life span	7	7
Gripping safety	4	9
Material	5	7
Maintenance	4	8
Mobility	3	6
Total score	28	53



**Figure 4:**Design 1



**Figure 5:** Design 2

### 3.4 Chapter Conclusion

Various matters related to the methodology and project implementation plan have been drawn in detail. Among the issues discussed are related to project implementation which includes drawings and simple comprehensive analysis. Designs have also been discussed in this chapter covering several types of drawings such as orthographic and isometric drawing and actual products. All of these drawings and actual products are depicted on each position. Also discussed are the welding process used.

### 4.0 Results And Discussions

The modification of car jack into a gripper has been seriously discuss and focused base on concept modifications, analysis to determine the end product design. Therefore the Modifications of The Car Jack Into an Internal Expanding Parallel Arms Gripper Using a Reinforced Rubber Strips, specifically the Scissors type has undergone time versus distance analysis so that its performance criterion will not fail in any sense. Certain main physical features of the design are determined through practical considerations with reasonable assumptions. Figures 2 and 3 show the Pictorial view of the modified car jack and a ratchet. From table 3 and 4, time versus distance and selection of design and it was discovered that at the maximum raising height of 15.19 cm for gripper is the most suitable height for maximum gripping force. Reinforced rubber strips used as the anti slipping medium has greatly supports the gripping conditions. Factors such as the number of turns per seconds for the screw jack depends on how fast it rotate depending on the user. There by it is to conform that the modification done on the Car Jack is considered safe ,reasonable and practical.



Reinforced rubber strips for optimum gripping on upper and lower jaw.

### 5.0 CONCLUSIONS

The existing design of the car jack was modified by introduction of reinforced rubberised strips embeded onto the upper and lower clamping jaw for maksimum clamping forcce. The main advantages of the modified car jack design over the existing design are that the modified car jack designed will save time, easy handling and need less human energy to operate. Problems associated with Ergonomics is there by overcome which is also one of the main fundamentals in designing the modifications of the car jack. The limitation of this design is that it is only capable of pulling pipe with the maximum weight load of 500 kg.

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