DESIGN AND FABRICATION OF PNEUMATIC LIFTING TABLE

A Thesis report submitted to the department of Mechanical Engineering for the partial fulfillment of the degree of Bachelor of Science in Mechanical Engineering.

A Thesis By

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APPROVAL

This is to certify that the project on **"Design and Fabrication of Pneumatic Lifting Table."** By Md Ashik Ali (ID No: BME 1901017077), Rahul Kumar (ID No: BME 1901017174), Md. Arman Ali (ID No: BME 1901017589), Shakilur Rahman (ID No: BME 1901017047) has been carried out under our supervision. The project has been carried out in partial fulfillment of the requirements of the degree of Bachelor of Science (B.Sc.) in Mechanical Engineering of years of 2022 and has been approved as to its style and contents.

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DECLERATION

We hereby, declare that the work presented in this project is the outcome of the investigation and research work performed by us under the supervision of Md. Minhaz Uddin, Lecturer, Department of Mechanical Engineering, Sonargaon University (SU). We also declare that no part of this project and thesis has been or is being submitted elsewhere for the award of any degree.

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ABSTRACT

The incentive of this project is to provide an alternative method for lifting heavy weight vehicles in the range of 15 kg by means of designing a pneumatic lifting device, where compressed air contrived through a compressor is the main source of providing lift to the vehicle. Furthermore, the objective of this final year project is to add further functionality to existing heavy weight lifters, by allowing maneuverability of the lifted vehicle. In this project, the design of the pneumatic heavy weight lifter is thoroughly explained, along with the specifications and scope. The selection of various parts for the design has been made with the product feasibility towards its functionality in mind. It is vital to acknowledge that the selected parts have been able to meet with the design requirements.

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Chapter 01 Introduction

1.1 General

A hydraulic fluid power system is defined as a means of power transmission in which relatively in compressible fluid is used as the power transmitting media. The primary purpose of pneumatic system is the transfer of energy from one location to another location and this energy into useful work.

In this project of the fabricated model of will describe the working principles as well as hydraulic machines application and its advantages. Efforts have been taken to show the path of hydraulic fluid as it is applied and released. The system pressure can be generated in the form of any physical action which result a compression over the pneumatic pressure which is developed in the form of air compressing externally can be applied to activate system. There is a constant relation between pressure density, and volume, According to Bernoulli's equation.

Lift tables are used to raise and position work pieces for ergonomic access. They are used for material positioning, load positioning, or lifting. This lifting has a pneumatic power source and is safe for heavy paint applications and other hazardous locations. This lift comes with alternative power sources.

1.2 Pneumatic Lifting tables are comprised of five major components:

1. **Platform:** This is the top of the lift table where lifted product sits. It can be supplied in a variety of sizes.
2. **Base:** This is the bottom of the structure that rests on the floor. It contains the track the scissor legs travel in.
3. **Scissor legs:** These are the vertical members that allow the platform to change elevation.
4. **Pneumatic cylinder:** The most common industrial scissors lifts are actuated by one, two, or three single-acting Pneumatic cylinders. These allow the lift table to lift and lower.
5. **Air Compressor:** Most Pneumatic scissor lifts are powered by an air compressor. These provide power to the Air Cylinder which actuates the lift table.

1.3 Some Types Of pneumatic lift table:

1. Vestil Pneumatic Scissor Lift Table
2. Global Industrial Mobile Scissor Lift Table
3. Roughneck 44501 Air & Hydraulic Lift Table Cart
4. Bishamon EZU-15 Pneumatic Lift Table

1.4 History of Pneumatics:

The first example of a pneumatics application can be tracked to as far back as the first century, when the ancient mathematician of Greek origin, best known as the Hero of Alexandria, wrote about his ingenious inventions that were run by either wind or steam. However, none of his considerations revealed intentions of operating pneumatic devices for transporting objects. On the other hand, German physicist Otto von Guericke (1602-1686) moved a little further by inventing the vacuum pump, a device capable of drawing either air or gas from any vessel it is attached to. He illustrated that vacuum pump air pressure could be utilized in order to separate pairs of copper enclosures called hemispheres.

The word “pneuma” Comes from Greek and means wind. The word pneumatics is the study of air movement and its phenomena is derived from the word pneuma. Today pneumatics is mainly understood to means the application of air as a working medium in industry especially the driving and controlling of machines and equipment.

Pneumatics has for some considerable time between used for carrying out the simplest mechanical tasks in more recent times has played a more important role in the development of pneumatic technology for lifting.

Pneumatic systems operate on a supply of compressed air which must be made available in sufficient quantity and at a pressure to suit the capacity of the system. When the pneumatic system is being adopted for the first time, however it wills indeed the necessary to deal with the question of compressed air supply. The key part of any facility for supply of compressed air by means using reciprocation compressor. A compressor is a machine that takes in air, gas at a certain pressure and delivered the air at a high pressure. Compressor capacity is the actual quantity of air compressed and delivered and volume expressed is that of the air at intake conditions namely at atmosphere pressure and normal ambient temperature.

The compressibility of the air was first investigated by Robot Boyle in 1962 and that found that the product of pressure and volumes of particular quantity of gas,

The usual written as

$PV= C$ (or) $P_1V_1= P_2V_2$

In this equation the pressure is the absolute pressured which for free is about 14.7psi and is of courage capable of maintaining a column of mercury, nearly 30 inches high in an ordinary barometer. Any gas can be used in pneumatic system but air is the mostly used system now a days.

1.4.1 Selection of Pneumatics:

Mechanization is broadly defined as the replacement of manual effort by mechanical power. Pneumatic is an attractive medium for low cost mechanization particularly for sequential (or) repetitive operations. Many factories and plants already have a compressed air system, which is capable of providing the power (or) energy requirement and control system (although equally pneumatic control systems may be economic and can be advantageously applied to other forms of power).

1.4.2 Pneumatic Power:

Pneumatic systems use pressurized gases to transmit and control power. Pneumatic systems typically use air as the fluid medium because air is safe, low cost and readily available.

1.4.3 Capsule Transportation:

The capsule was first invented in 1886 and allowed people to transport items by placing them in a container. People in Victorian England were the first known to use capsule pipelines to transmit telegrams from one telegraph station to another.

1.4.4 Postal Systems:

Scottish engineer William Murdoch (1754 to 1839) was the first to apply pneumatics to postal services, but there is little evidence that he went further than suggesting the transmission of letters and packages through pneumatic tubes. American merchant John Wanamaker (1838 to 1922) installed a pneumatic system in the United States Post Office when he was postmaster general and in department stores to transport money from one section to the other.

1.4.5 Public Transportation:

Pneumatics was also applied to public transportation. A notable example is the efforts of American inventor Alfred Beach (1826 to 1896). In 1867, Beach demonstrated a pipe able to transport a handful of passengers, giving birth to the pneumatic subway line. However, the line only lasted for a few months, terminated after Beach was unable to gain permission to extend the distance of the subway.

1.5 Comparison of Pneumatics to Hydraulics:

Both pneumatics and hydraulics are applications of fluid power. Pneumatics uses an easily compressible gas such as air or a suitable pure gas—while hydraulics uses relatively incompressible liquid media such as oil. Most industrial pneumatic applications use pressures of about 80 to 100 pounds per square inch (550 to 690 kPa). Hydraulics applications commonly use from 1,000 to 5,000 psi (6.9 to 34 MPa), but specialized applications may exceed 10,000 psi (69 MPa).

1.6 Advantages of pneumatics:

1. **Simplicity of design and control:** Machines are easily designed using standard cylinders and other components, and operate via simple on-off control.
2. **Reliability:** Pneumatic systems generally have long operating lives and require little maintenance. Because gas is compressible, Equipment is less subject to shock damage. Gas absorbs excessive force, whereas fluid in hydraulics directly transfers force. Compressed gas can be stored, so machines still run for a while if electrical power is lost.

3. **Safety:** There is a very low chance of fire compared to hydraulic oil. Machines are usually overload safe.

1.7 Advantages and Disadvantages of Lifting Mechanisms:

Lifting Mechanism	Advantages	Disadvantages
Pneumatic	• High accuracy • Generates large lifting forces • Overall operating environment versatility • No environment risks (from leaks) • Lowest initial cost	• Requires constant flow/operation • High operating costs • Limited individual versatility (by actuator size)
Hydraulic	• Produces greater force than pneumatic • Constant force and torque • Does not require constant flow/operation	• Risk of environmental leaks • Larger area footprint
Mechanical	• Greatest control, precision, accuracy • Scalable operations • Quietest operation • No environment risks (from leaks)	• More expensive • Lifting capability limited by motor • Motor fatigue from use • Not suitable for hazardous or flammable applications

1.7 Scope:

For this project, the design for heavy weight pneumatic lifter must be able to comply with the constraints set forward for this experiment. Hence, the scope of research for pneumatic lifter Is divided into the following three sub-categories:

1. Pneumatic Motor
2. Lifting Mechanism

1.8 Objectives:

The objectives of this thesis are...

- To design a machine that can achieve high accuracy in lifting using smooth and efficient fluid power.
- To use the mechanical power for lifting vehicles to a certain height.
- To raise large, heavy loads through relatively small distances

Chapter 02 Literature Review

This chapter discusses in detail, the present pneumatic technology available. The first section provides an overview of the functionality of pneumatics in general, along with their various applications. Following sections describe the various principles relating to pneumatics, along with the benefits of using such systems. Furthermore, a comprehensive research on various types of pneumatic motors, pistons, and sensors is clearly illustrated here. Pneumatic systems in fixed installations, such as factories, utilize compressed air since compressing atmospheric air can be a source of sustainable supply. The air regularly has moisture removed, and a small measure of oil is supplemented at the compressor in order to avoid corrosion and provide lubrication to the numerous mechanical constituents. One perceptible and valuable benefit in utilizing pneumatic-power for factory applications is that operators need not worry about poisonous leakages, due to the fact that the gas is ordinarily pure air. However, compressed gases that present an asphyxiation hazard, such as nitrogen—often referred to as OFN (oxygen-free nitrogen), could be used be smaller stand-alone systems. Every compressed gas besides air is considered as a suffocation hazard—including nitrogen, which makes up to approximately 78% of air. Compressed oxygen (approx. 22% of air) would not lead to suffocation, but it is not utilized in pneumatically powered devices due to it being more expensive, a fire risk and offering no performance improvement over air. Handy pneumatic tools and small vehicles, the likes of Robot Wars machines are generally powered by compressed carbon dioxide, since containers that are devised to hold it such as fire extinguishers are easily accessible, and the phase change between liquid and gas makes it possible to obtain a larger volume of compressed gas from a lighter container than what is required by compressed air. Carbon dioxide is a suffocating agent and can be a freezing hazard if vented unfittingly. Pneumatic Lifters predominantly use pneumatic cylinders of low friction as source of lifting power and are capable of providing a cost effective solution to many lifting applications. Compared with vacuum lifting devices, pneumatic lifts are normally more suited to manual handling operations, which require precise or controlled pick and place movements, such as vehicle line-side operations in automotive plants.

Pneumatic Lifters may utilize numerous pneumatic cylinder arrangements as the key power source, which would provide substantial lifting capabilities. Guided pneumatic lifters allow a solid mounting platform for tooling and the option of powered rotation in one or more axes. This design makes for particularly good drum handling equipment; where controlled movements prove beneficial to operators engaged in drum pouring or barrel tipping operations.

No matter how grand the scale, sophisticated the design or intricate the planning, all great undertakings are born from diminutive origins--a core concept or ideal from which all subsequent ideas and actions radiate. Whether it is a solution to a commonly encountered problem, an easier way to complete a task or even a challenge to what is considered possible by current technology, a concept is born simple. Ideas aspire to be great. They are useless on their own but given the right environment and support, ideas can help foster immense possibilities. Once a concept is founded the possibilities of how to proceed abound. From a stream of ideas and theories, a natural progression of events and list of necessities will become apparent to the inventor.

These will become steps along the way that must be complete before the final goal may be attained. Think of the great mind of the past, sitting on the earth, gazing at the heavens, longing to touch the stars. Astrophysics and space shuttles where certainly not created overnight but guided by the list of necessities along the way, scientists put these great contributions into existence and thus made the distance separating man from his skyward endeavor that much shorter. Of course few goals are as lofty as space travel but the central idea of invention, from concept through completion is no different and the elation felt after a project is complete is no less great. While no astronauts were created in the undertaking of this project, I pushed many boundaries and explored new areas of understanding. In keeping with the previously mentioned structure of invention, this projects concept was created with only one goal in mind. The project, which even in its infancy was referred to simply as "the lift", was called to life in response to a single question from my mentor Loren Schreiber (faculty Professor and Director of technology at San Diego State University's Department of Theatre), "Why don't we make our own [lift system] and rent it out" Little did I know at the time how large an impact such a simple proposition would have on my graduate school career

For better understanding of the projects creation, it is necessary to pause and give context to the Department of Theatre at San Diego State University and their use of technology in a theatre environment. While the department boasts a large scenic construction shop, with access to an impressive amount of tools and advanced equipment, it is what is hiding in the basement that truly defines its level of technical sophistication. Managed by Loren Schreiber, The San Diego Theatre Arts Research Laboratory, or S.T.A.R. Lab, is housed in the lower level of the Don Powell Theatre Building. It is here that technical theatre magic happens. The lab is a facility dedicated to the creation and refinement of machinery and effects, specialized for use in not only the schools theatrical productions, but professional theatres across the country. Often aligned under the single category of "automation" technology used by students in the lab includes, but is certainly not limited to, the areas of pneumatics, hydraulics, programmable logic controllers, radio controlled electronics, and motorized which systems,

Add in the access to fully operational wood and metalworking shops, also housed in the threatre, and student can produce almost anything the mind can envision. While, when lift in disarray, the lab can resemble a mad scientists workshop, this is a space where amazing invention in theatre technology come into being; a place where students are limited only by their own imaginations and desire to learn. It is in this breeding ground for creativity that I spent the majority of my time as a graduate student. Whether working as an assistant building an effect system for a show or going to class, the STAR Lab quickly became my home away from home. Given the nature of the lab, it should be no surprise that this is where the idea of the lift project first came about. It was during an informal conversation between Schreiber and me that he revealed the San Diego Opera was in need of a lift system for their production of Faust in the coming season and they were inquiring around town for possible rental of such a system. This is when Schreiber posed what seemed it that time, to be a simple proposition, "Why don't we make our own [lift system] and rent it out?" What followed was a series of back and forth discussion of hypothetical scenarios and systems, which could be manufactured in the Departments metal shop, rented to the San Diego Opera and then returned for the Departments own use.[1]

Gaffar G Momin, et al found that design as well as analysis of a hydraulic lift. Concentionally a scissor lift of jack is employed for lifting a vehicle to change a tire, to gain access to travel to the underside of the body of the vehicle to appropriate height, and lots of other applications also such lift can be used for various purposes like maintenance and many material handing operations. The lift can be of mechanical, pneumatic, or hydraulic type.the design of the lift described within the paper is developed in such way that the lift is operated by mechanically means by using a pantograph such that the overall cost of the scissor lift is reduced to some extent. In our case, we required the lift is portable and also works without consuming any electric power source so they decided to use a hydraulic hand pump to power the hydraulic cylinder also a design can make the lift more compact and much suitable for medium scale work. Finally, the analysis of the scissor lift was done in ANSYS and also all responsible parameters were analyzed to check the design of the lift. [2]

M. Kiran Kumar, et al concluded that force that is also acting on the hydraulic scissor lift when it is extended and contracted. Generally, a hydraulic scissor lift is used for lifting and also holding heavyweight components. Material selection plays a very important role in designing a machine and also influence on several factors such as durability, reliability, strength, resistance which finally helps to increase the life of scissor lift. The hydraulic lift design such a way that must be portable, compacts and more suitable for the medium type of load handling application. Drafting and drawing of the hydraulic system of a scissor lift are done using solid works software with suitable modeling and imported to Ansys workbench software for meshing and analysis of lift. Hence, the analysis of this scissor lift includes total deformation load, and equivalent stresses were done in Ansys software and all other responsible parameters of the lift were analyzed to check yhr compatibility of the design value. The computational values of two different material such as aluminum and mild steel are also compared for the best results. [3]

Uttam Panwar, et al stated that operating mechanism and study of hydraulic lift. This research paper solves material handling and provides comfort to the operator. This paper shows the study and also the design of hydraulic scissor lift components. It can lift up 300kg of load with a raises of 3.5ft. The main aim of this research paper is to study the hydraulic scissor lift also design and fabrication of hydraulic scissor lift. In this case, lift has to be moveable and portable so rollers or wheels are provided for motion at the bottom side of the lift and also we can’t use electric power in this lift so they use a hydraulic pump. Hydraulic generate more and accurate pressure. By use of this mechanism and design hydraulic lift became more efficient and can operate in industries. The purpose of this research is to use all components effectively gives good results. [4]

Prushotam & Apsad Ali, done the work on, Design and Analysis of Hydraulic Scissor Lift by using ANSYS, this thesis paper mainly tells about force following up on the pressure driven scissor lift when it is constructed and expanded. In most of the cases hydraulic lift is used to lifted heavy objects like vehicle in automobile industry. In planning a machine material choice is a key job and further more changes on a few factors, for instance, unsteady quality, quality obstruction which at long last increase the life of scissor lift. The plan is performed by considering pressure driven hydraulic scissors lift as a convenient, conservative and much appropriate for medium and high level of load carrying mechanisms.

Plan of water powered framework scissor lift is finished utilizing CATA V5R20 with appropriate demonstrating and imported to ANSYS V17.0 for examination and stimulation. As a result the static observation of the pneumatic scissor lift incorporates add up to imbalanced force, load Equivalent pressure, force, weight was performed in ANSYS and every single reliable parameter were anatomized with the end goal to cheek similarly of the outlines. The computational estimations of three different materials, for example, auxiliary steel, carbon fiber and aluminum Alloy are located at for best outcomes. From all the experimental analysis performed, it can be clearly seen that carbon fiber material has extremely low weight than other conventional materials being use for manufacturing of machines like scissor lifts. The design and manufacturing of a remote work platform lifted by a hydraulic cylinder was carried out to meet the need of design standards. [5]

Gaffar Momin, Karan Dalvi, Rohan Hatti, rohit Devare, Faisal Bargi, completed the work on, Design –Manufacturing and Inspection of Hydraulic Scissor Lift, Where the subsequent paper descrides the design, construction as well as analysisof a hydraulic scissor lift. Conventionally a scissor lift is used for lifting up the body to maximum height, and many other applications also such as lifts can be used for various purposes like maintenance, cleaning and manymaterial handling work operations. It can be built of mechanical pneumatic of hydraulic type. The detailed overall design explained in this paper is developed keeping in mind that the lift can be operated by mechanical means by using pantograph so that the overall cost of the scissor lift is reduce as much as possible. In our case our lift was required to be designed in such a way that a portable and also work without consuming any electric power supply so we decided to use a hydraulic hand pump to pressurized the cylinder also such design can make lift more compact and much suitable for medium and high scale operations. In last, the analysis of the scissor lift was completed in ANSYS designing software & all responsible parameters were demonstrated in order to check the compatibility and required of the design values. The design development and manufacturing of a remote work platform lifted up by a hydraulic cylinder was carried out in proper way by meeting the required design standard norms. The remote work platform is operated by hand pump ergonomics of a workman working in the workshops or company is a responsibility of an organization. Operators comport is also an important thing. Hence, by making this hydraulic lift we improved the comfort level of the operator working on the cold forging machine in his work place.

Our main motive behind developing this lifter was providing comport to the operator and material handing comfort to the operator and material handling. This was considered as a radical improvement in the productivity by the company or industry. We can design scissor lift for high load also if a proper high capacity hydraulic cylinder is considered. The pneumatic scissor lift mechanism is very simple in operation and does not require regular maintenance. It can lift very heavy and high loads. The main constraint of this device is it has high initial value, but has a very less operating cost. To obtain high strength the shearing tool should be heat treated. [6]

Chapter 03 Contraction Process

3.1 Process of Project:

- Creating an idea for Design and construction of Design and fabrication of pneumatic lifting table.
- And designing a block diagram to know which components need to construct it.
- Setting all components, then assembling the all block in a board and finally run the system & checking.

3.2 Reference Figure:

Fig 3.1: Reference Figure of Pneumatic Lifting Table.

3.4 Working Principle:

The complete fabricated model picture of pneumatic lifting table is shown below. The upper base is mounted on the linkage as shown in the diagram and is connected to the piston of the pneumatic cylinder. The both sides of the piston are connected to the single stage reciprocating air compressor through the solenoid valve.

Air from a single stage air compressor enters the push button direction control valve and is directed to the pneumatic actuator. The pneumatic actuator is a double acting cylinder and the compressed air extends the piston. The piston rod acts as piston in the hydraulic line and pressurizes the hydraulic fluid. Thus the hydraulic fluid enters the delivery pipe through a filter arrangement. The pressurized fluid is made to act on a hydraulic cylinder placed on a table arrangement. The hydraulic fluid then extends the hydraulic piston. The end of the piston rod is connected to a load pan. Thus the pan extends along with the piston rod and lifts the load.

Pressurized air at 3bar from the compressor hits the piston of the double acting pneumatic cylinder from the blank end side via five ports and two positions (5/2) push button operated directional control valve. As a result, the piston of the pneumatic cylinder extends. This in turn pressurizes the enclosed oil in the hydraulic line, as per Pascal's law. This is due to the extension of the piston rod of the pneumatic cylinder and the rod acts as piston to the pneumatic line. The pressurized fluid at 69bar will act on the blank end of the piston of the single acting pneumatic cylinder. A large amount of load carrying capacity of approximately 1300Kg would be delivered by the pneumatic cylinder rod. This could be achieved by connecting metallic plate (or pan) to the rod of the hydraulic cylinder by means of nuts and bolts. This arrangement can be used for lifting the loads as well as to clamp the work piece on the table during machining. By operating push button of the 5/2 DCV, air from the compressor enters into the pneumatic cylinder through the rod end side. This makes the piston to retract and the oil from the reservoir is drawn into booster portion of the pneumatic cylinder. By depressurizing the push button of 5/2 DCV, the spool of the DCV assumes its initial position. As a result, air pressure on the blank end side of the cylinder pushes the rod of the piston into the booster area. High force delivered by the piston creates an increase in the pressure of the fluid, which in turn enters into the blank end region of the single acting pneumatic cylinder. This causes rising of the load via the cylinder, which depends on the cross sectional area of the piston. In order to lower the load cylinder, needle valve connected to the main hydraulic line is operated, which causes the draining of the oil from the hydraulic cylinder to the reservoir.

3.5 Required Instruments:

1. Air Compressor

2. Pneumatic Air Cylinder

3. Frame.

3.5.1 Air Compressor:

An air compressor is a pneumatic device that converts power (using an electric motor, diesel or gasoline engine, etc.) into potential energy stored in pressurized air. By one of several methods, an air compressor forces more and more air into a storage tank, increasing the pressure. When the tank's pressure reaches its engineered upper limit, the air compressor shuts off. The compressed air, then, is held in the tank until called into use. The kinetic energy provided by the compressed air can be used for a variety of applications such as pneumatic tool as it is released air and the tank depressurizes. When tank pressure reaches its lower limit, the air compressor turns on again and re-pressurizes the tank. An air compressor must be differentiated from a pump because it works for any gas/air, while pumps work on a liquid.

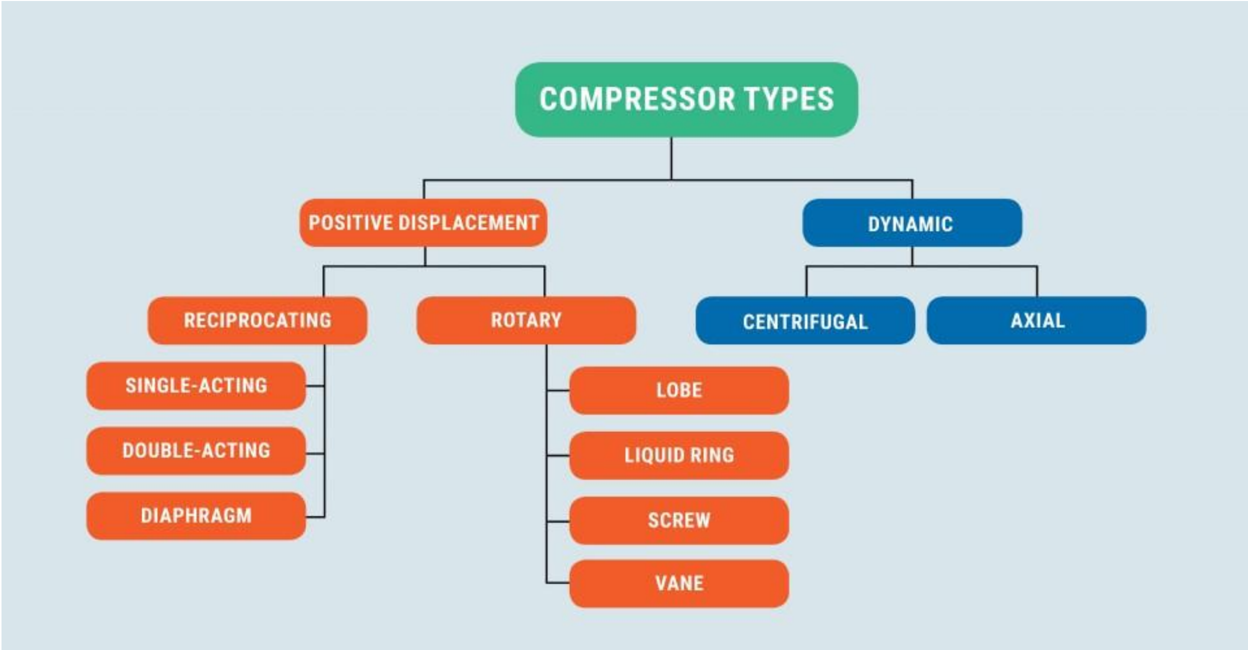
Fig 3.2: Air compressor

Working Principle: Air compressors work by forcing atmospheric air under pressure to create potential energy that can be stored in a tank for later use. Just like an open balloon, the pressure builds up when the compressed air is deliberately released, converting the potential energy into usable kinetic energy.

Types of Air Compressor:

There are two basic types of air compressors:

- Positive displacement, and.
- Dynamic.



Reciprocating Single Acting Compressor:

As the piston moves downward through the cylinder, air is sucked in the inlet valve. When the piston moves up through the cylinder the inlet valve closes and the discharge won't open until a certain amount of force is applied.

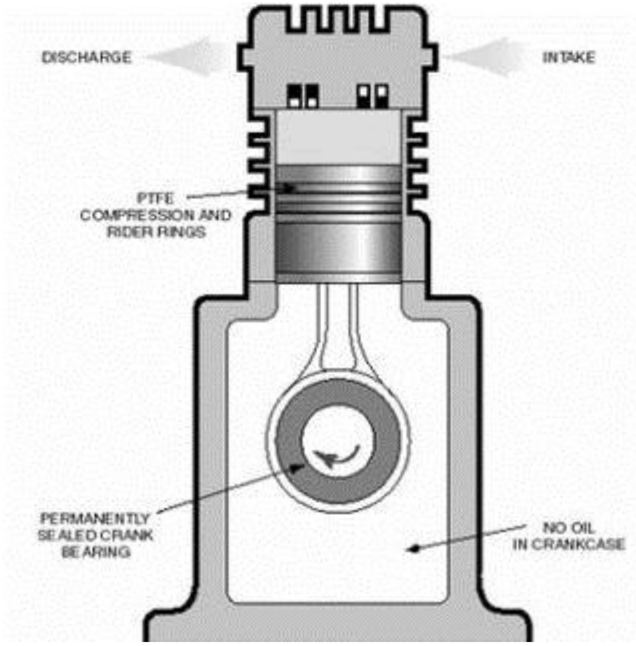


Fig 3.3: Diagram of Single Acting Cylinder

Working Principle:

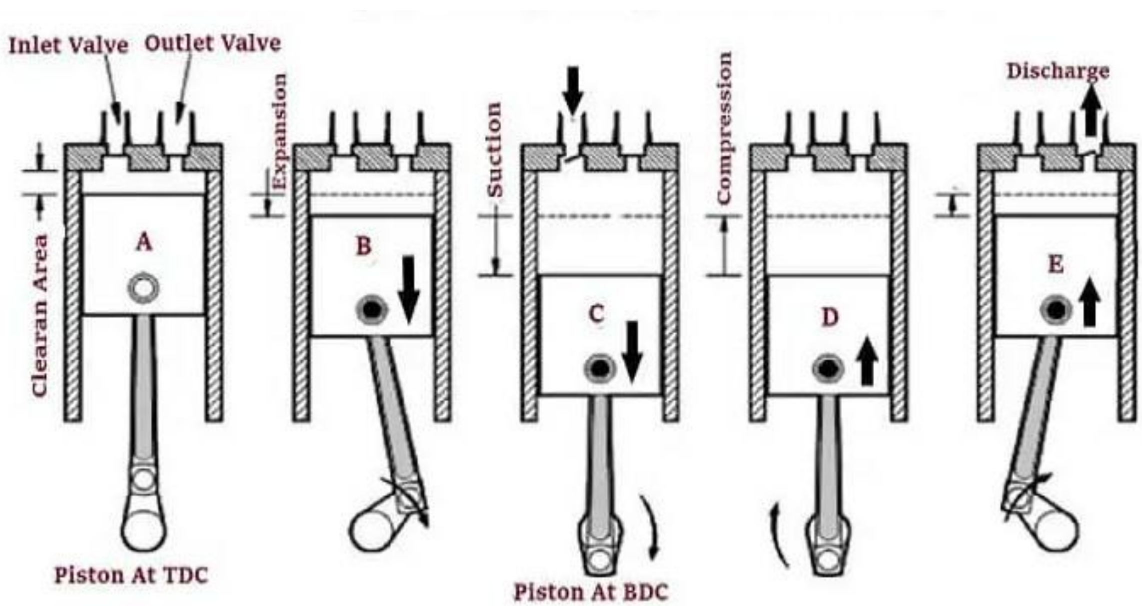


Fig 3.4: Working circle of Reciprocating Single Acting Compressor

The single-acting air compressor working principle is very simple that is given below in detail.

This reciprocating compressor consists of an intake valve, an exhaust valve, a cylinder, valves, crankshaft and a piston.

As the piston moves in a downward direction, then the air pressure in the compressor cylinder drops lower than the pressure of the atmosphere. This pressure variation opens the inlet valve and draws air into the cylinder until the piston is completed its downward stroke.

As the piston moves up, the pressure builds up, and ultimately it touches the exhaust pressure. At this point, the outlet valve is opened for discharging the air. Then the air is sent to the storage tank.

At the end of the delivery stroke, a certain amount of high-pressure air remains in the clearance area.

When the piston stops the suction stroke, then the air in the clearance area increases until the air pressure drops below the pressure of the atmosphere. At this moment, the fresh air enters in the cylinder, the intake valve opens, and this cycle repeats.

Since the single-acting air compressor only has one valve at the top of the cylinder. And there is only one compression cycle for each revolution of the crankshaft.

Parts of Air Compressor:

The main parts of the marine air compressor are:

1) Cylinder liner

2) Piston

3) Piston Rod

4) Connecting rod

5) Big end bearing and Main bearing

6) Crank shaft

7) Frame and crankcase

8) Oil pump

3.5.2 Pneumatic Air cylinder:

Pneumatic cylinders (sometimes known as air cylinders) are mechanical devices which use the power of compressed gas to produce a force in a reciprocating linear motion. Like hydraulic cylinders, something forces a piston to move in the desired direction. The piston is a disc or cylinder, and the piston rod transfers the force it develops to the object to be moved. Engineers sometimes prefer to use pneumatics because they are quieter, cleaner, and do not require large amounts of space for fluid storage. Because the operating fluid is a gas, leakage from a pneumatic cylinder will not drip out and contaminate the surroundings, making pneumatics more desirable where cleanliness is a requirement. For example, in the mechanical puppets of the Disney Tiki Room, pneumatics are used to prevent fluid from dripping onto people below the puppets.

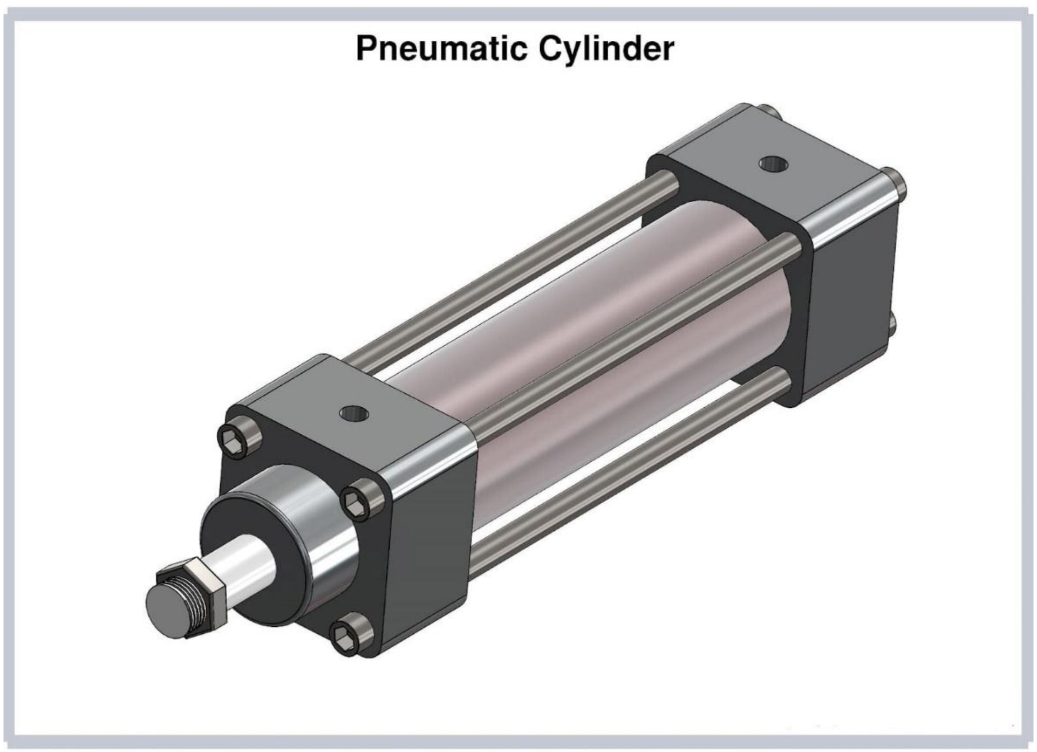


Fig 3.5: Pneumatic cylinder

Types of Pneumatic Cylinders:

There are three main types of pneumatic cylinders, including:-

1. Single Acting Cylinders.
2. Double Acting Cylinders.
3. Telescoping Cylinders.

Single Acting Cylinder:

A single-acting cylinder in a reciprocating engine is a cylinder in which the working fluid acts on one side of the piston only. A single-acting cylinder relies on the load, springs, other cylinders, or the momentum of a flywheel, to push the piston back in the other direction.

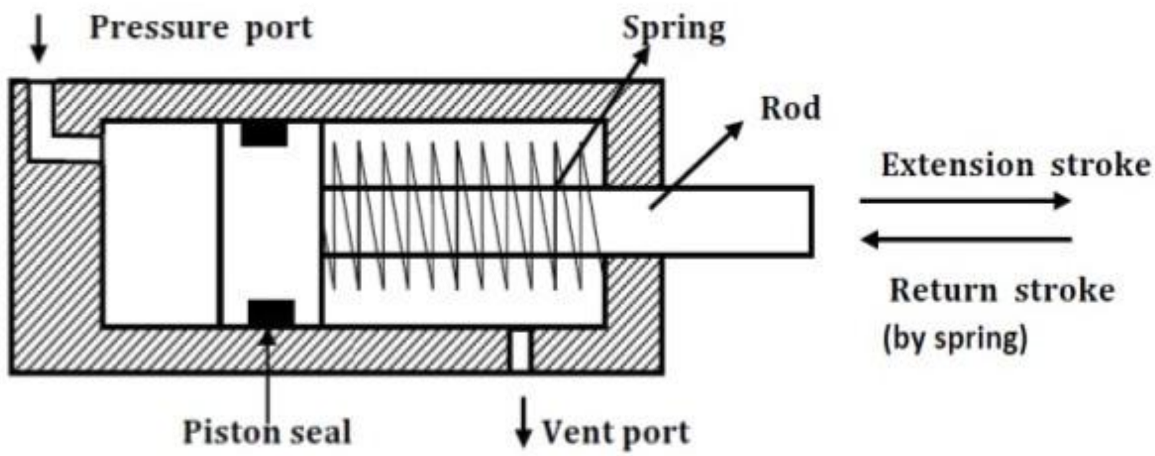


Fig 3.6: Diagram of Single Acting pneumatic Cylinder

Components of Pneumatic Cylinders:

The following are the components of pneumatic cylinders:

• **Pneumatic Cylinder Bore:** The pneumatic cylinder bore houses and protects the internal components. It is closed by two end caps: the front-end (cylinder head) and the rear- end (cylinder cap). The front-end cap is located adjacent to where the piston rod extends while the rear-end cap is mounted on the opposite side. One or both caps have ports that introduce pressurized air inside the bore. Seals with cushioning capability are placed between the bore and the caps to prevent leakage and high impact during actuation.

- **Piston:** The piston is the disc inside the pneumatic cylinder, which serves as a movable partition that divides the chamber. It reciprocates back and forth in a straight line. As compressed air enters the port of the rear-end cap, it exerts pressure on the piston, which causes it to move away from the rear-end cap and for the piston rod to protrude. This movement is called positive or plus movement and the pressurized chamber which causes this movement is called the plus chamber. The minus chamber is located on the opposite side. The piston then returns to its original position. The manner of how the piston returns to its original position depends on its type. The amount of force generated by the pneumatic cylinder is equivalent to the air pressure multiplied by the area of the piston. The diameter of the pneumatic cylinder refers to the diameter of the piston or the inner diameter of the cylinder.

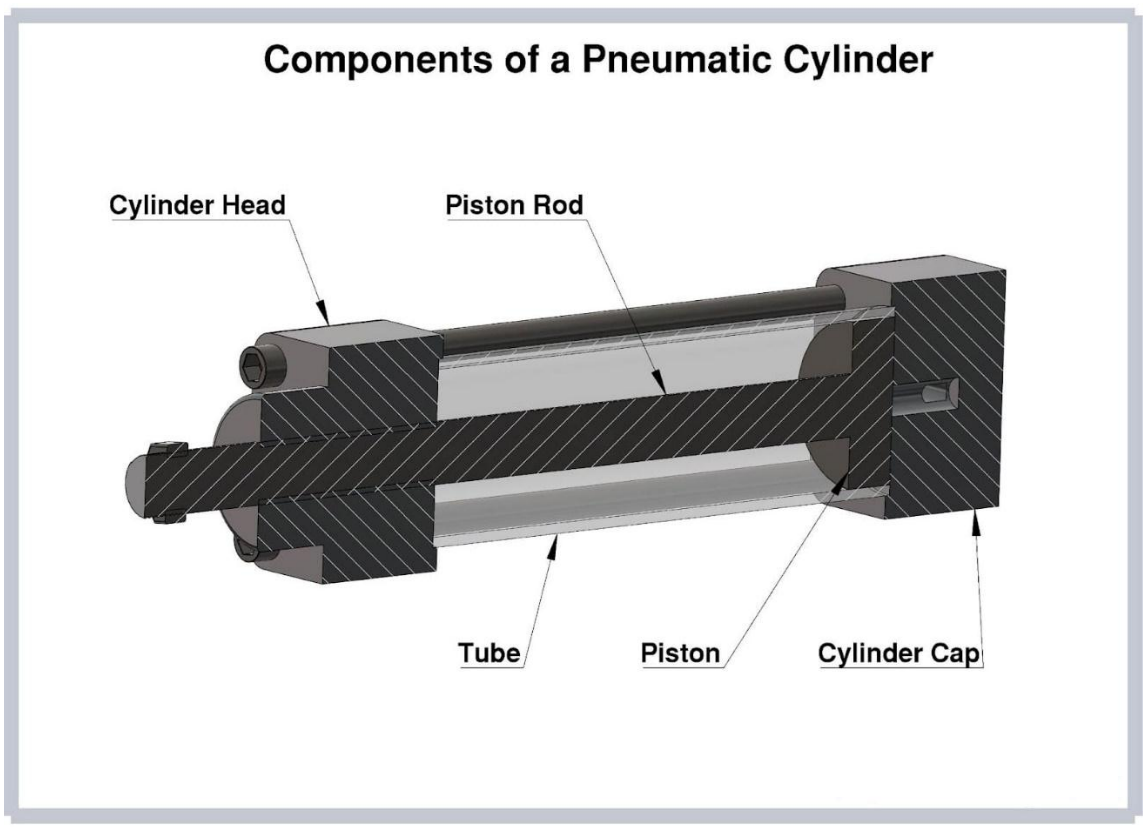


Fig 3.7: Components of Pneumatic Cylinder

- **Piston Rod:** The piston rod is connected and driven by the piston. It is attached to the machine element or objects to be pushed or pulled. The stroke length refers to the distance that the piston and the piston rod have traveled.

- **Piston Cushioning:** The piston cushioning lowers the speed of the piston and rod assembly before it reaches the end cap. It helps to reduce impact, noise, and vibration at the end of every stroke and enables the piston to move at faster velocities.

- **Piston Static Seal:** The piston static seal ensures an airtight sealing between the piston and the rod.

- **Piston Seal:** A piston seal ensures an airtight sealing between the piston and the chamber. It prevents air from leaking to the other side of the chamber.

- **Piston Guide Rings:** Piston guide rings prevent direct metallic contact between the piston and the cylindrical chamber during sliding motion. They absorb radial forces acting in the cylinder. They are mounted in the piston and made of chemical resistant, low friction, and self-lubricating plastics such as PTFE and polyamide.

- **Sensors:** Sensors are used to detect the linear position of the piston inside the cylinder. They are important for positioning applications. Reed switches and Hall-effect sensors are the commonly used pneumatic cylinder sensors.

- **Tie Rods:** Tie rods are the threaded steel rods that hold the end caps to the pneumatic cylinder bore. A static seal is present between the end cap and bore interface. The tie rods run around the length of the cylinder. A pneumatic cylinder can have 4-20 tie rods depending on the size and force it produces, which makes the cylinder bulkier. The tie rods also protect the cylinder from possible impact and shock.

3.5.3 Frame:

A cylinder with piston arrangement is connected with a zigzag pattern. Two pipes connected with ball valves connect the air tank with the cylinder. When one valve is opened, the air rushes out into the cylinder. Therefore the piston moves in one direction. The rod connected with the piston pushes the zigzag flame so that the lift moves up. When the other ball valve is opened, the air inside the cylinder is released. Therefore the lift comes down. The main objective of Zigzag Pneumatic Lift project is developing a lift system for lifting any weight using air pressure. In this project, we stored high pressure air in a tank. A zigzag pattern is connected with a cylinder with piston arrangement. The cylinder and the air tank are connected by the two pipes with ball valves. When one ball valve is opened, the high pressure air will enter into the cylinder. Hence, the piston will move in one direction. The rod connected with the piston pushes the zig -zag frame so that the lift moves up. When we open the other ball valve, the air inside the cylinder is released. So, the lift comes down.

Fig 3.8: Frame of Pneumatic Lifting Table

Chapter 4 Result and Discussion

Final Design Parameters:

Specification of Pneumatic Lifter:

Specification	Pneumatic Lifter
Length	0.9144 m
Width	1.016 m
Power Source	Air Compressor
Maximum Lift Load	Approx. 100 kg
Overall Project Weight	981 $\frac{kg-m}{sec^2}$
Required Air Pressure	100-200 psi
Elevated Height	0.7366 m
Cylinder Diameter	.050 m

Cylinder diameter 50mm = 0.05m

Cylinder Area (A) = $\frac{\pi d^2}{4}$ [Here, A = Area, d = dia-meter]

$= \frac{\pi(0.05)^2}{4}$

$= 1.963*10^{-3}$ m^2

01. Calculation to time & velocity:

Assume, Pressure (P) = 100 psi

= 100*6895 [Here, 1 psi = 6895 N/m^2]

= 689500 N/m^2

We Know,

$P = \frac{F}{A}$ [Here, P = Pressure, F= Force, A = Area]

or, F= P*A

$= 689500*1.963*10^{-3}$

=1353.49 N

Again, Mass of the object 100 kg

Now,

F=ma [Here, F = Force, m = mass of letting table, a = Acceleration]

or, $a = \frac{F}{m}$

$= \frac{1353.49}{100}$

= 13.53 m/s^2

As the distance required for the table to travel is 074 m, the time required to lift the table could be calculated from the following equation:

$S = ut + \frac{1}{2} at^2$ [Here, S = Distance, u = initial velocity, a = acceleration, t = time]

or, $0.74 = 0 + .5*13.53* t^2$

or, t = 0.33 sec

Velocity calculation for lifting table:

The time required to lifted the table is ascertained to be 0.33 sec.

Therefore the lifted velocity is as follows:

v = u + at [Here, v = final velocity, a = acceleration, t = time]

or, v = 0 + 13.53*0.33

or, v = 4.47 m/s

02 Calculation to time & velocity:

Assume, Pressure (P) = 150 psi

= 150*6895 [Here, 1 psi = 6895 N/m^2]

= 1034250 N/m^2

We Know,

$P = \frac{F}{A}$ [Here, P = Pressure, F= Force, A = Area]

Or, F= P*A

=1034250*1.963*10^{-3}

=2030.23 N

Again, Mass of the object 15 kg

Now,

F=ma [Here, F = Force, m = mass of letting table, a = Acceleration]

or, $a = \frac{F}{m}$

$= \frac{2030.23}{100}$

= 20.30 m/s^2

As the distance required for the table to travel is 07366 m, the time required to lift the table could be calculated from the following equation:

$S = ut + \frac{1}{2} at^2$ [Here, S = Distance, u = initial velocity, a = acceleration, t = time]

Or, 0.74 = 0 + .5*20.30 * t^2

or, t = 0.27 sec

Velocity calculation for lifting table:

The time required to lifted the table is ascertained to be 0.27 sec.

Therefore the lifted velocity is as follows:

$v = u + at$ [Here, v = final velocity, a = acceleration, t = time]

or, $v = 0 + 20.3 * 0.27$

or, $v = 5.48$ m/s

03 Calculation to time & velocity:

Assume, Pressure (P) = 200 psi

$= 200*6895$ [Here, 1 psi = 6895 N/m^2]

$= 1379000$ N/m^2

We Know,

$P = \frac{F}{A}$ [Here, P = Pressure, F= Force, A = Area]

or, $F = P*A$

$= 1379000*1.963*10^{-3}$

$= 2706.977$ N

Again, Mass of the object 15 kg

Now,

$F = ma$ [Here, F = Force, m = mass of letting table, a = Acceleration]

or, $a = \frac{F}{m}$

$= \frac{2706.977}{100}$

$= 27.07$ m/s^2

As the distance required for the table to travel is 07366 m, the time required to lift the table could be calculated from the following equation:

$S = ut + \frac{1}{2}at^2$ [Here, S = Distance, u = initial velocity, a = acceleration, t = time] or, $0.74 = 0 + .5*27.07*t^2$

or, $t = 0.23$ sec

Velocity calculation for lifting table:

The time required to lifted the table is ascertained to be 0.02823 sec.

Therefore the lifted velocity is as follows:

$v = u + at$ [Here, v = final velocity, a = acceleration, t = time]

or, $v = 0+ 27.07 *0.233$

or, $v = 6.31$ m/s

Pressure	Mass	Distance	Acceleration	Time	Velocity
100 psi	100 kg	0.74 m	13.53 m/s^2	0.33 sec	4.47 m/s
150 psi	100 kg	0.74 m	20.30 m/s^2	0.27 sec	5.48 m/s
200 psi	100 kg	0.74 m	27.07 m/s^2	0.23 sec	6.31 m/s

Discussion:

The above figures illustrate in detail the finalized design, which is largely bound on the first original concept that has been heavily modified in order to provide both vertical as well as horizontal motion to the lifted vehicle. A comprehensive market research that was carried out revealed that the required lift for safely lifting the required weight set forth of 15 kg. The reason why the original design was heavily modified in order to formulate the final product is that, expansive research revealed that for the sake of safety when it comes to the handling of heavy weight items in the aforementioned weight, a predetermined path of motion was essential so as to formulate a safe work area surrounding the lifted vehicle, and offering practicality by allowing motion through different areas so as to ease the process of most essential requirements of lifting a vehicle such as removing the engine, gearbox, and the carrying out of undercarriage maintenance in specified areas. In order to completely adhere to the requirements of the design objectives, measures for absolute mobility were integrated into the design by the installation of heavy duty industrial castors made out of cast nylon, each capable of withstanding a weight exceeding 1 ton, while stress strain analysis indicated that the proposed design should be capable of withstanding respectively of forces are 689500 N/m^2, 1034250 N/m^2 and 1379000 N/m2 which equals approximately 100 kg, thereby surpassing the required value. From the calculations carried out based on information attained from the technical specifications of materials selected, it was then found that the time required to lift a vehicle weighing 100 kg, respectively of total time 0.33 sec, 0.27 sec and 0.23 sec, at respectively uniform velocity are 4.47 m/s, 5.48 m/s and 6.31 m/s.

Chapter 5 Conclusion

5.1 Conclusion: Instead of using hydraulic lift we have used mechanically operated pneumatic lift which is more cost efficient and portable. We have designed scissor lift in such a way that it has reduced design complexities. All the design calculations are performed taking into consideration the dimensions of car and all the safety issues. Modifications can be done by providing rollers to the lower base so it could be portable. Also by providing upper magnetic base ferrous material can be held easily.

5.2 Recommendations:

Due to the uniqueness of this design, and it being one of the first attempts at providing a viable alternative to current hydraulic heavy weight lifters, there are a variety of recommendations for future development of the current pneumatic lifter. The first is to providing a more efficient design by means of installing a single feed in mechanism for torque, which would allow for a design that is more compact, and hence, cheaper to operate. Furthermore, the application of stronger, more advanced materials, along with a more developed feed in mechanism for torque, could offer numerous benefits by providing a lifting capability to cars weighing in excess of 5 tons. Enhanced safety standards and controllability of the heavy weight lifter could also be enhanced by the integration of electronic sensors and components into the design, which would provide an automated operation. The current design has been developed according the realization of the latest technical expertise available with the regards to pneumatic devices. However, it is expected that the current design would be capable of coping with future development in this field, with the advent of more advanced pneumatic motors, whereby a simple exchange of the motor could offer superior performance. It is therefore most recommended that any addition to the current design should be done, with the perspective of future performance of design.

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