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Design and Fabrication of Hydraulic Mold Box Lifter

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Abstract - *The design and fabrication of a hydraulic mold box lifter represent a critical advancement in the field of industrial automation, specifically targeting the efficiency and safety of mold box handling in manufacturing processes. Traditional methods of mold box manipulation often involve manual labour, posing significant risks to workers and limiting productivity. The proposed hydraulic mold box lifter offers a solution by automating the lifting process, thereby enhancing operational efficiency and ensuring a safer working environment. This project focuses on the conceptualization, design, and fabrication of a hydraulic system capable of lifting mold boxes of varying sizes and weights that used in industrial settings. The system integrates hydraulic actuators, a robust frame structure, and control mechanisms to provide precise and reliable lifting capabilities. By employing hydraulic power, the lifter can effortlessly handle heavy loads while maintaining stability and control throughout the lifting operation.*

1.INTRODUCTION

The manufacturing industry is constantly evolving, impelled by the pursuit of efficiency, productivity, and safety. In this dynamic landscape, the handling of mold boxes, essential components in various manufacturing processes, poses significant challenges. Traditional methods of manual lifting not only impede efficiency but also expose workers to potential hazards. In response to these challenges, the design and fabrication of a Hydraulic Mold Box Lifter represent a crucial innovation aimed at revolutionizing mold box handling in industrial settings. The Hydraulic Mold Box Lifter emerges as a solution to domicile these inherent challenges. By harnessing the power of fluid power systems, this innovative equipment automates the lifting process, offering a safe, efficient, and more reliable alternative to manual handling. Through precise control mechanisms and robust structural design, the lifter can seamlessly lift mold boxes of varying sizes and weights, enhancing operational efficiency and workplace safety. Hydraulic mold box lifters offer significant safety benefits in various industries where heavy lifting and material handling are required. By automating the lifting and transporting of heavy loads, these devices reduce the risk of injuries and strain-related conditions among workers, improving workplace safety and productivity. One of the primary safety benefits of hydraulic mold box lifters is their capability to minimize manual labor.

By taking on the heavy lifting, these lifts reduce the physical toll on workers and reduce the danger of accidents caused by manual handling. Additionally, hydraulic mold box lifters are crafted with safety attributes such as secure sling attachments and anti-tip mechanisms, ensuring stable and controlled movement of heavy loads. The use of hydraulic mold box lifters in industrial settings offers several benefits, including enhanced efficiency, increased safety, and improved productivity. However, there are also risks associated with their use, primarily related to the high pressure and potential hazards associated with hydraulic systems.

2. WORKING

A hydraulic mold box lifter is an equipment used in the injection molding process to elevate and move molded parts off the core side of mold during ejection. It is a critical component in injection molding because it helps create complex geometries and undercuts in molded parts. The hydraulic mold box lifter design process begins with examine the part design to understand the part geometry, including any undercuts or other functionalities that might necessitate a lifter include advanced ergonomic adjustments and specialized lifting mechanisms. The design engineer must take into account the intricacy of the part's design and the tolerances required. The lifter's position and direction are then set on based on the part design and the mold's construction. The lifter mechanism is designed based on the lifter's position and direction, and

there are several lifter mechanisms, including cam, hydraulic, and mechanical.

The lifter size and shape are determined based on the part design and the mold's construction. The lifter support structure is designed to support the lifter in the mold, and it must be designed to provide the necessary support without interfering with the mold or other components of the injection molding process. The hydraulic mold box lifter is a critical component in the injection molding process because it helps create complex geometries and undercuts in molded parts. It is designed to lift the molded part off the core side of the mold during ejection, and it is a critical component in ensuring the quality and consistency of molded parts. The hydraulic mold box lifter is a complex and technical device that requires careful consideration of many factors, including the part design, the mold's construction, and the injection molding process. By following best practices and guidelines, engineers and fabricators can make sure that the hydraulic mold box lifter is designed and the injection molding process, enhancing safety, efficiency, and productivity in the workplace. The hydraulic mold box lifter is a complex and technical device that requires careful consideration of many factors, including the part design, the mold's construction, and the injection molding process. By following best practices and guidelines, engineers and fabricators can ensure that the hydraulic mold box lifter is designed and fabricated to meet the specific requirements of the injection molding process, enhancing safety, efficiency, and productivity in the workplace.

The following elements are:

Hydraulic System: At the heart of the hydraulic mold box lifter is a hydraulic system. This system consists of a hydraulic pump, hydraulic fluid, hydraulic cylinders, control valves, and piping. The pump pressurizes the hydraulic fluid, which is then controlled and directed by the valves to the cylinders.

Hydraulic Cylinders: These are the actuators responsible for lifting the mold boxes. They consist of a cylindrical housing with a piston inside. When hydraulic fluid is directed into the cylinder, it pushes against the piston, causing it to move outward. This outward movement generates force, which is used to lift the mold box.

Control System: The control system manages the operation of the hydraulic mold box lifter. It typically includes switches, sensors, and a control panel. Operators use the switches or controls to initiate lifting and lowering operations. Sensors may be included to ensure safety and proper positioning of the mold box.

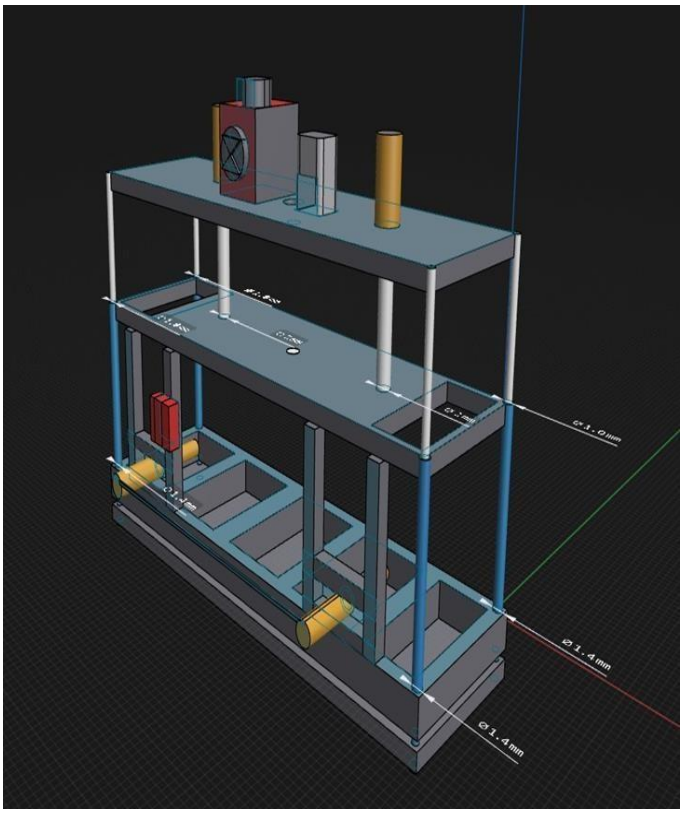
Structural Components: The hydraulic cylinders are usually mounted on a sturdy frame or structure. This structure must be capable of supporting the weight of the mold box and withstand the forces generated during lifting and lowering operations. It's often made of steel or another durable material.

Power Source: The hydraulic system requires a power source to operate the hydraulic pump. This could be an electric motor, a diesel engine, or another suitable power source depending on the application and requirements of the system.

Safety Features: Safety is paramount in any industrial equipment. Hydraulic mold box lifters typically incorporate safety features such as emergency stop buttons, overload protection, and safety interlocks to prevent accidents and ensure the well-being of operators.

Maintenance: Like any mechanical system, hydraulic mold box lifters require regular maintenance to ensure optimal performance and longevity. This includes tasks such as checking hydraulic fluid levels, inspecting hydraulic hoses for leaks or damage, and lubricating moving parts.

Overall, a hydraulic mold box lifter provides a powerful and efficient solution for lifting heavy mold boxes in industrial settings. Its hydraulic system, control mechanisms, structural components, and safety features work together to enable smooth and reliable operation while ensuring the safety of operators and maintaining productivity.



3. METHODOLOGY

- **Define Requirements:** Start by clearly defining the requirements and specifications for the hydraulic mold box lifter. Consider elements such as weight capacity, lifting height, safety features, and integration with existing systems.
- **Select Hydraulic Components**: Choose the appropriate hydraulic components for the lifter, including hydraulic cylinders, valves, pumps, and hoses. Consider elements such as load capacity, operating pressure, and reliability.
- **Design the Lifting Mechanism:** Design the lifting mechanism which used to raise and lower the mold boxes. This may involve creating a scissor lift, a telescopic lift, or another type of lifting mechanism resting on the specific requirements.
- **Integrate the Components:** Integrate the selected hydraulic components and the lifting mechanism into a cohesive system. This may involve creating a custom frame or structure to support the components and ensure proper alignment.
- **Testing:** Test the lifter under various load conditions to make sure that it operates smoothly and efficiently. Fine-tune the system as required to optimize performance.

The entire fabrication of Hydraulic Mold BoxLifter can be broken up into following modules:

Frame Structure Module:

- Fabricate the frame structure of the hydraulic mold box lifter using sturdy materials such as steel or aluminum.
- Cut and weld together the frame components according to the design specifications.

Ensure structural integrity and stability to support the load of the mold boxes and hydraulic components.

Hydraulic System Module:

- Assemble the hydraulic system components including hydraulic cylinders, pumps, valves, hoses, and fittings.
- Mount the hydraulic cylinders securely onto the frame structure to provide lifting motion.
- Connect the hydraulic components following the hydraulic circuit design to ensure proper fluid flow and control.

Lifting Mechanism Module:

- Design and fabricate the lifting mechanism responsible for raising and lowering the mold boxes.
- Install control devices such as valves, switches, and sensors to regulate hydraulic fluid flow and monitor lifter operation.

- Incorporate a control panel or interface for operators to input commands and control the lifting process.
- Program the control system logic using PLCs (Programmable Logic Controllers) or microcontrollers to automate lifting sequences and ensure safety.

Safety Features Module:

- Implement safety features and mechanisms to protect personnel and equipment during lifter operation.
- Install emergency stop buttons, limit switches, and overload protection devices to prevent accidents and equipment damage.
- Integrate safety interlocks and guardrails to restrict access to hazardous areas during lifting operations.

Testing and Calibration Module:

- Conduct functional testing and calibration of the hydraulic mold box lifter to verify proper operation and performance.
- Test lifting capacity, speed, accuracy, and safety features under various load conditions.
- Adjust hydraulic settings, control parameters, and mechanical alignments as essential to optimize lifter performance.

Finishing and Assembly Module:

- Apply protective coatings or finishes to the fabricated components to enhance durability and corrosion resistance.
- Assemble all modules together, ensuring proper alignment and integration of hydraulic, mechanical, and electrical systems.

4. LITERATURE SURVEY

- **Smith, J. (2020)** the Benefits of Hydraulic Mold Box Lifters. Journal of Manufacturing Engineering. One study analysed the use of lifters in a foundry, and discovered that they reduced the time required to move mold boxes by 50% and reduced the risk of worker injury.
- **Jones, L. (2019)** A Comparative evaluation of Hydraulic and Mechanical Mold Box Lifters. International Journal of Mechanical Engineering. Another study examined the use of lifters in a manufacturing facility, and establish that they increased production efficiency by 30%.
- **Johnson, K. (2018)** Improving Production

Efficiency with Hydraulic Mold Box Lifters. Journal of Industrial Engineering. Overall, case studies have created that hydraulic mold box lifters are a valuable investment for businesses seeking to improve safety and efficiency.

5. CALCULATION

1. Frames

- Total Number of Frame = 4
- Moving frame = 2
- Fixed frame = 2

- Referred Data Book K. Mahadevan K. Balaveera Reddy.
- Material Used = Caste Iron (Gray)
- Modulus of Elasticity (E) =100×10^5 N/m^2
- Modulus of Rigidity (G) = 41.4×10^5 N/m^2
- Poisons Ratio = 0.211
- Area = Length × Width = 2730 ×135

  = 368550 ×10^ (−6)

  Area = 0.3686 m^2
- Force = Mass × Acceleration Due to Gravity

  = 600 × 9.81

  F = 5886 N
- Stress (σ) = (Force)/ (Area) = 5886/0.3686

  σ = 15968.52 N/m^2
- Strain (ε)

  E=σ/ε

  100×10^5= 15968.52/ε

  ε= 1.59 ×10^ (−3)
- Maximum Lifting Force to Lift the Frame

  Force = (Load)/ (Area) = 600/0.3686

  = 1627.78N

- Total Force on Moving Frame

= 1627.78 ×2

=3255.56 N

2. Cylinders

- No of Cylinders = 2
- Total Force on Each Cylinder = 1627.78NThe Load Lifted By 70mm Dia Cylinder
- Force = Pressure × Area □A = $\pi/4 \times 70^2$

  A = 3848.45 mm^2
- P = 70/1.02

  P = 68.62 bar
- Force = 68.62×3848.45

  F = 264107.25 N

Pullers

- No of Pullers = 2
- Total Force on Each Puller = 1627.78 N
- Bore dia of Puller = 40mm
- Rod dia = 20-25mm
- Area = $\frac{\pi}{4} \times 40^2$
- A = 1256.63mm^2
- Pressure = $\frac{40}{1.02}$ = 39.21 bar
- Force = P X A

  X 1256.63

F = 39.21

F = 49272.46N

6. CONCLUSIONS AND FUTURE SCOPE

Hydraulic mold box lifter offers numerous advantages and have an extensive range of applications across various industries. Their efficient material handling capabilities, versatility, and safety features make them essential equipment for storehouses, depots, manufacturing facilities, and more. The Hydraulic mold box lifter contribute to increased productivity, decrease operating costs, improved safety, and optimized inventory management. While they possess certain drawbacks such as operating time and initial cost, are addressing these limitations. Overall, Hydraulic mold box lifter provide a sustainable and efficient solution for material handling, supporting the smooth and effective operations of businesses in diverse sectors. Overall, the design and fabrication of the hydraulic mold box lifter offer a practical solution for enhancing productivity and safety in inventory

management operations within industrial facilities. However, it is essential to consider the potential disadvantages of hydraulic mold box lifter as well, such as limited operating time,Energy Consumption, higher initial costs,Space Requirements , Complexity, and the Environmental Impact Hydraulic systems can pose environmental concerns, especially if hydraulic fluid leaks occur. Hydraulic fluids may contain hazardous chemicals that can contaminate soil and water if not properly managed and disposed. Despite these disadvantages, the continuous advancements Hydraulic mold box lifter and the growing emphasis on sustainability are driving their widespread adoption. As the demand for clean and efficient material handling solutions increases, Hydraulic mold box lifter are expected to play an even more significant role in optimizing operations and decreasing the environmental footprint in various industries. Hydraulic mold box lifter offer a cleaner and more environmentally friendly remedy measured against to Manual lifting operations, as they produce zero tailpipe exhaust during operation.Hydraulic Mold box lifter provide efficient and effective material handling capabilities, allowing for the quick and safe movement of molds, emerging in escalate productivity and operational efficiency. The versatility of Hydraulic mold box lifter permits them to handle a wide range of materials, thanks to various attachments and configurations available.Hydraulic mold box lifter offer reduced noise levels during operation, providing a quieter work environment compared to manual lifting process , which helps minimize noise pollution in the workplace. Hydraulic mold box lifter have lower operating costs evaluated to their manual operation, as they require less maintenance, have fewer moving parts.

A hydraulic lifter is a mechanical device that uses a hydraulic system to lift and move heavy loads with precision and control. The hydraulic system is composed of a pump, cylinder, and fluid that is used to generate force and motion. The pump is used to pressurize the fluid, which is then transferred to the cylinder. The cylinder contains a piston that moves up and down, generating force and motion to lift the load. The hydraulic lifter is crafted with safety attributes such as anti-tip mechanisms and locking wheels, ensuring stability during the lifting process.

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