VACUUM ASSISTED MATERIALS FILLING MACHINE

A PROJECT REPORT

Submitted by

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in partial fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

IN

MECHANICAL ENGINEERING

M.KUMARASAMY COLLEGE OF ENGINEERING, KARUR

ANNA UNIVERSITY: CHENNAI 600 025

MAY 2024

M.KUMARASAMY COLLEGE OF ENGINEERING, KARUR

BONAFIDE CERTIFICATE

Certified that this project report "VACUUM ASSISTED MATERIALS FILLING MACHINE" is the bonafide work of "MOHANRAJ.S (927622BM054), NATHISH.M (927622BME056)" who carried out the project work during the academic year 2023 – 2024 under my supervision. Certified further, that to the best of my knowledge the work reported herein does not form part of any other project report or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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This project report has been submitted for the end semester project viva voce Examination held on _______________

INTERNAL EXAMINER

DECLARATION

We affirm that the Project titled **"VACUUM ASSISTED MATERIAL FILLING MACHINE"** being submitted in partial fulfillment of for the award of **Bachelor of Engineering in Mechanical Engineering**, is the original work carried out by us. It has not formed the part of any other project or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

Student name	Signature
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Name and signature of the supervisor with date

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INSTITUTIONS VISION & MISSION

Vision

- To emerge as a leader among the top institutions in the field of technical education.

Mission

- Produce smart technocrats with empirical knowledge who can surmount the global challenges.
- Create a diverse, fully-engaged, learner-centric campus environment to provide quality education to the students. Maintain mutually beneficial partnerships with our alumni, industry and professional associations.

DEPARTMENT VISION, MISSION, PEO, PO & PSO

Vision

- To create globally recognized competent Mechanical engineers to work in multicultural environment.

Mission

- To impart quality education in the field of mechanical engineering and to enhance their skills, to pursue careers or enter into higher education in their area of interest.
- To establish a learner-centric atmosphere along with state-of-the-art research facility.
- To make collaboration with industries, distinguished research institution and to become a centre of excellence

PROGRAM EDUCATIONAL OBJECTIVES (PEOS)

The graduates of Mechanical Engineering will be able to

- PEO1: Graduates of the program will accommodate insightful information of engineering principles necessary for the applications of engineering.
- PEO2: Graduates of the program will acquire knowledge of recent trends in technology and solve problem in industry.
- PEO3: Graduates of the program will have practical experience and interpersonal skills to work both in local and international environments.
- PEO4: Graduates of the program will possess creative professionalism, understand their ethical responsibility and committed towards society.

PROGRAM OUTCOMES

The following are the Program Outcomes of Engineering Graduates: Engineering Graduates will be able to:

1. Engineering knowledge: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

2. Problem analysis: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

3. Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. Conduct investigations of complex problems: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

5. Modern tool usage: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

6. The engineer and society: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

7. Environment and sustainability: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

8. Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

9. Individual and team work: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

10. Communication: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. Project management and finance: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PROGRAM SPECIFIC OUTCOMES (PSOs)

Graduate: The students will demonstrate the abilities

Real world application: To comprehend, analyze, design and develop innovative products and provide solutions for the real-life problems.

Research oriented innovative ideas and methods: To adopt modern tools, mathematical, scientific and engineering fundamentals required to solve industrial and societal problem

Course Outcomes	At the end of this course, learners will be able to:	Knowledge Level
CO-1	Identify the issues and challenges related to industry, society and environment.	Apply
CO-2	Describe the identified problem and formulate the possible solutions	Apply
CO-3	Design / Fabricate new experimental set up/devices to provide solutions for the identified problems	Analysis
CO-4	Prepare a detailed report describing the project outcome	Apply
CO-5	Communicate outcome of the project and defend by making an effective oral presentation.	Apply

MAPPING OF PO & PSO WITH THE PROJECT OUTCOME

Course Outcomes	Program Outcomes												Program Specific Outcomes		
	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
CO-1	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO-2	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO-3	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO-4	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3
CO-5	3	3	3	3	2	2	2	2	3	3	2	2	3	2	3

Table of Content

CHAPTER 1

ABSTRACT

This paper presents the design and development of a vacuum assisted material filling machine The vacuum-assisted is an innovative solution designed to improve the efficiency and accuracy of filling processes across various industries, including food, pharmaceuticals, chemicals, and cosmetics. This machine leverages vacuum technology to handle and transfer a wide range of materials such as powders, granules, and liquids into designated containers or packaging with minimal spillage and enhanced precision.The core principle of the vacuum-assisted filling machine involves creating a controlled vacuum within a chamber, which draws the material from the source and guides it into the target container. By utilizing a vacuum, the system can effectively reduce air contamination, prevent material loss, and maintain a consistent fill level, even when dealing with viscous or delicate substances. This technique is especially advantageous for handling sensitive products, as it minimizes exposure to air and reduces the risk of oxidation or contamination

The vacuum-assisted filling machine offers several advantages over traditional filling methods, including higher speed, improved filling accuracy, reduced product waste, and enhanced hygiene. It is an ideal solution for industries requiring precise, clean, and efficient filling processes. The development of this machine is aimed at enhancing operational productivity, reducing material costs, and meeting stringent quality standards in manufacturing.

The closed-system design typically found in vacuum-assisted filling machines reduces the exposure of materials to the environment, enhancing safety and hygiene, especially important in sectors like food and pharmaceuticals.

INTRODUCTION

The Vacuum Assisted Material Filling Machine is a cutting-edge solution designed to revolutionize the way materials are filled into containers. This innovative machine utilizes vacuum technology to streamline the filling process, minimizing manual labor and maximizing efficiency. With its ability to handle a wide range of materials, including powders, granules, and small particles, this machine is poised to transform industries such as pharmaceuticals, food processing, and cosmetics.

The Vacuum Assisted Material Filling Machine addresses the long-standing challenges associated with traditional filling methods, including material waste, contamination, and labor-intensive processes. By harnessing the power of vacuum technology, this machine ensures accurate and precise filling, while also reducing the risk of material spillage and contamination.

This introduction sets the stage for exploring the features, benefits, and applications of the Vacuum Assisted Material Filling Machine.

PROBLEM IDENTIFICATION

Vacuum Pump Failure: Failure of the vacuum pump can lead to reduced filling efficiency and accuracy.

Clogged Vacuum Lines: Blockages in the vacuum lines can reduce the vacuum pressure, leading to filling errors.

Worn or Damaged Seals: Worn or damaged seals can lead to vacuum leaks, reducing the machine's efficiency.

Electrical or Electronic Component Failure: Failure of electrical or electronic components can lead to machine downtime and reduced productivity**.**

Mechanical Component Wear: Wear and tear on mechanical components, such as bearings and gears, can lead to machine downtime and reduced productivity**.**

Material Particle Size or Shape: Materials with irregular particle sizes or shapes can lead to filling errors or reduced machine efficiency.

Material Density Variations: Variations in material density can lead to inaccurate filling and reduced machine efficiency.

Incorrect Machine Settings: Incorrect machine settings can lead to filling errors, reduced efficiency, and increased downtime.

Poor Maintenance: Poor maintenance of the machine can lead to reduced efficiency, increased downtime, and premature wear of components.

Operator Error: Operator error, such as incorrect material loading or improper machine operation, can lead to filling errors and reduced machine efficiency**.**

Dust or Powder Explosions: Dust or powder explosions can occur if the machine is not properly designed or maintained.

Noise Pollution: Noise pollution can be a problem if the machine is not properly designed or maintained.

Vibration: Vibration can be a problem if the machine is not properly designed or maintained**.**

Electrostatic Discharge: Electrostatic discharge can be a problem if the machine is not properly designed or maintained.

CHAPTER 2

LIST OF COMPONENTS

1.vacuum cleaner

2.stainless steel

3.Rubber caster wheel

4.Sack bag

5.screw

6.cutting machine

COMPONENTS AND ITS FUNCTIONS

VACUUM CLEANERS

Vacuum cleaners work by using the motor to create a pressure difference between the intake and exhaust. This pressure difference creates a flow of air that generates suction, allowing the vacuum to pick up dirt and debris.

FUNCTIONS

Motor: Provides the power to create suction

Fan: Creates a flow of air that generates suction

Vacuum Chamber: The area where the dirt and debris are collected

Intake: The opening through which dirt and debris enter the vacuum chamber

Exhaust: The opening through which clean air is released

STAINLESS STEELS

Stainless steels are steels containing at least 10.5% chromium, less than 1.2% carbon and other alloying elements. Stainless steel's corrosion resistance and mechanical properties can be further enhanced by adding other elements, such as nickel, molybdenum, titanium, niobium, manganese, etc

FUNCTIONS

Corrosion Resistance: Stainless steel is highly resistant to corrosion, which means it can withstand exposure to water, moisture, and other corrosive substances.

Durability: Stainless steel is incredibly durable and can withstand heavy use and harsh environments.

Aesthetics: Stainless steel has a sleek, modern appearance that is often used in architectural and design applications.

Recyclable: Stainless steel is 100% recyclable, making it an environmentally friendly choice.

RUBBER CASTER WHEEL

A rubber caster wheel is a type of wheel that is made of rubber and is designed to be attached to the bottom of a moving object, such as a chair, table, or equipment. The wheel is typically mounted on a swivel or pivot, allowing it to rotate and move in different directions**.**

FUNCTIONS

Mobility: Rubber caster wheels enable easy movement and mobility of objects, such as furniture, equipment, and machinery.

Floor Protection: The rubber material protects floors from damage, scratches, and scuffs, which can be caused by heavy or sharp objects.

SACK BAG

A sack bag, also known as a sack or burlap bag, is a type of bag made from a coarse, woven fabric, typically made from jute, burlap, or canvas.

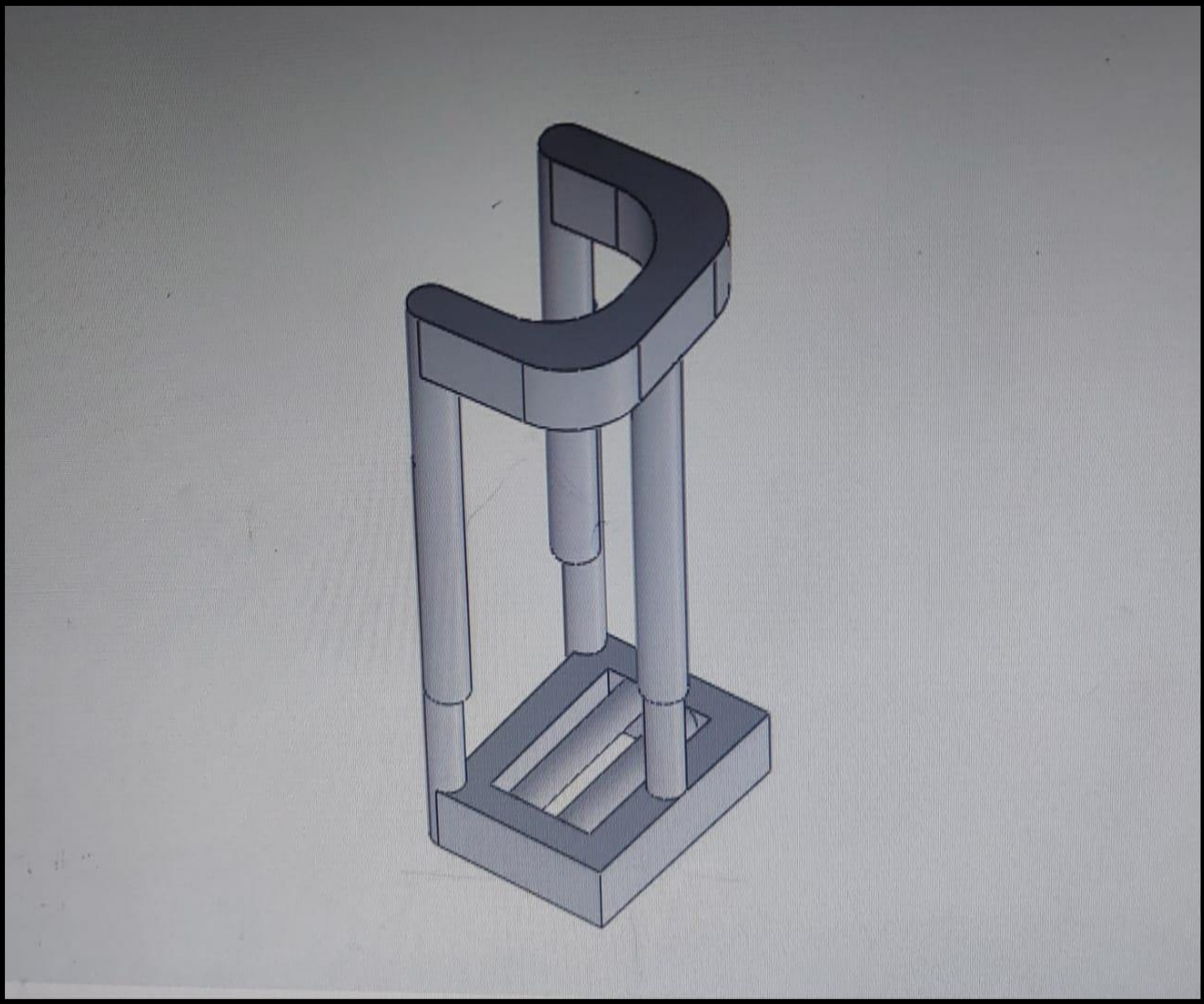
SCREW

A screw is a type of fastener that consists of a cylindrical shaft with a spiral ridge, known as a thread, cut into its surface. Screws are used to join two or more objects together by inserting the screw into a hole or slot and turning it to create a secure connection.

CUTTING MACHINE

A cutting machine is a device or tool used to cut or separate various materials, such as metals, woods, plastics, and fabrics. Cutting machines can be manual, semi-automatic, or fully automatic, and are commonly used in various industries.

DIAGRAM



CHAPTER 3

COST ESTIMATION

S.NO	COMPONENTS	COSTS
1	vacuum cleaner	1399
2	stainless steels	300
3	Rubber caster wheel	100
4	Sack bag	50
5	screw	50
6	cutting machine	200
	TOTAL	**2099/-**

CHAPTER 4

RESULT AND DISSCUSION

- **Results**
-
- **Improved filling accuracy**: Vacuum-assisted filling machines can achieve high filling accuracy, reducing waste and improving product quality.
- **Increased efficiency**: These machines can fill containers at a faster rate than manual or gravity-fed filling methods, increasing productivity and reducing labour costs.
- **Reduced material waste**: Vacuum-assisted filling machines can minimize material waste by accurately measuring and dispensing the correct amount of material.
- **Improved product consistency**: By ensuring consistent filling volumes and material densities, vacuum-assisted filling machines can help maintain product consistency and quality.
- **Enhanced operator safety**: These machines can reduce the risk of operator injury by minimizing exposure to hazardous materials and reducing the need for manual handling.

- **Discussion**

Machine design and customization: The design and customization of vacuum-assisted filling machines can significantly impact their performance and efficiency. Factors such as container size, material type, and filling volume must be carefully considered.
Material characteristics: The properties of the material being filled, such as its density, flowability, and moisture content, can affect the performance of the vacuum-assisted filling machine.
Maintenance and troubleshooting: Regular maintenance and prompt troubleshooting areessential to ensure the reliable operation of vacuum-assisted filling machines.
Integration with other equipment: Vacuum-assisted filling machines can be integrated with other equipment, such as conveyors, cappers, and labelers, to create a comprehensive packaging line.
Cost-benefit analysis: A thorough cost-benefit analysis should be conducted to determine the feasibility and potential return on investment of a vacuum-assisted filling machine.

Conclusion

- **1 Enhanced Efficiency**: The vacuum mechanism significantly improves the speed and consistency of filling processes by reducing air pockets and ensuring a more even and controlled material flow.

- **2. Improved Product Quality:** By using a vacuum to assist in the filling, the risk of contamination and the presence of air bubbles are minimized, leading to higher product quality, especially for sensitive materials.

- **3. Reduced Waste:** The precision offered by this technology helps in reducing material waste, ensuring that the exact quantity is filled as required, thus optimizing the use of raw materials.

- **4. Versatility**: Vacuum-assisted filling machines can handle a wide range of materials, from liquids to powders and granules. This versatility makes them suitable for various industries, including pharmaceuticals, food processing, and chemical manufacturing.

- **5. Cost-Effectiveness**: Although the initial investment might be higher, the machine's ability to reduce waste, improve speed, and minimize the need for manual labour can lead to significant cost savings in the long run.

- **6. Enhanced Safety and Hygiene**: The closed-system design typically found in vacuum-assisted filling machines reduces the exposure of materials to the environment, enhancing safety and hygiene, especially important in sectors like food and pharmaceuticals.

- In conclusion, adopting a vacuum-assisted materials filling machine can be a strategic investment for industries looking to enhance their production processes, improve product quality, and achieve operational efficiency. Its application not only meets modern manufacturing standards but also provides a robust solution to various challenges in filling operations, making it an essential tool in automated and high-precision production environment

ADVANTAGE

Operational Advantages

- **Improved Filling Accuracy:** Vacuum-assisted filling machines minimize human error, ensuring consistent and precise filling volumes.
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- **Increased Efficiency**: Automated filling processes reduce labor costs, increase productivity, and optimize production workflows.
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- **Reduced Material Waste**: Vacuum-assisted filling machines minimize material waste, reducing costs and environmental impact.
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- **Enhanced Product Quality**: Consistent filling volumes and material densities ensure uniform product quality, meeting stringent industry standards.

Technical Advantages

- **Vacuum-Powered Filling**: Vacuum pressure ensures accurate and efficient filling, reducing the risk of overfilling or underfilling.
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- **Adjustable Filling Parameters**: Machines can be programmed to adjust filling volumes, rates, and pressures to accommodate various materials and container sizes.
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- **Integrated Sensors and Monitoring**: Advanced sensors and monitoring systems ensure real-time tracking of filling processes, enabling prompt detection and correction of any issues.

-
- **APPLICATION**

- **Chemical and Cosmetic**

- Filling of powders, granules, and liquids
- Filling of creams, ointments, and gels
- Filling of perfumes, fragrances, and essential oils

- **Automotive and Aerospace**

- Filling of lubricants, greases, and oils
- Filling of adhesives, sealants, and coatings
- Filling of composites, resins, and other materials

- **Packaging and Converting**

- Filling of bags, pouches, and sachets
- Filling of containers, tubs, and pails
- Filling of drums, barrels, and other large containers

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Automatic Material Filling Machine for IBM

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