Automated Material Handling Mechanism

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Abstract- *This project is related to transferring goods from a first horizontal to second horizontal conveyor comprising a substantially upright extending frame- endless drive arranged on the frame and drivable by a motor; at least one support member which is connected to endless drive and which is drivable in a circuit by means of the endless drive. At least one product carrier connected to the support member, wherein the product carrier is connected to the support member for rotation about lying shaft extending transversely of the frame, wherein the product carrier is connected drivably to no more than only one trolley. So, it is basically a vertical conveyor with a carriage which is mounted on endless chain and it lift boxes in vertical direction and dispatch them on another horizontal conveyor synchronized with it.*

Keywords- Vertical Conveyor System, Endless Drive Mechanism, Upright Extending Frame, Rotational Shaft, Trolley Connection, Horizontal Conveyor Synchronization, Vertical Lifting Mechanism, Dispatch Mechanism.

I. INTRODUCTION

Material handling involves short-distance movement within the confines of a building or between a building and a transportation vehicle. It uses a wide range of manual, semiautomated, and automated equipment and includes consideration of the protection, storage, and control of materials throughout their manufacturing, warehousing, distribution, consumption, and disposal. Material handling can be used to create time and place utility through the handling, storage, and control of material, as distinct from manufacturing, which creates form utility by changing the shape, form, and makeup of the material.

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. The main purpose of this project is to safely lift the load at the rate of 6m/min. This paper consist of, selection, the design of basic mechanical elements. This system is able to overcome the drawbacks of inclined Chain conveyor, achieves desired height and occupies less floor space as the material is transformed in vertically upward direction. This Chain Conveyor utilizes a continuous chain arrangement, carrying a series of the single pallet for lifting the load. The chain arrangement is driven by a motor, and the material suspended on the pallets is conveyed to the next floor. Automation is the use of control system for handling different processes and machineries to replace human efforts. Nowadays, more and more companies are switching to automation. The implementation of advanced automatic control system on the basis of industrial controllers enable us to programmatically perform a main handling systemeffectively. This paper will focus on the implementation of requirements to control the Chain conveyor. The use of automatic control on all parts of the machine system; which will play a major role in controlling all the parts of the system. Our research is about to fabricate an automated packaging machine system. Electrical DC motors control were used as actuators for the entire process to move the upper & lower convey Conveyor Chain used for transporting samples from one location to another, which would be packaged into a specific paper boxes later. Automated system reduces the labor cost and the production time with reduction of product packaging rate.

The purpose of this developmental research project was to design and build a vertical reciprocating conveyor to eliminate the need for workers carrying materials up and down stairs. More specifically the project's purpose was to eliminate machine operators at Phoenix Closures Incorporated being required to carry 5 gallon containers of plastic resin up and down an Offset Step Space Saver Stairway. This process is done to access a mezzanine to add colored plastic resin to a blender to correct an incorrect color blend.

A conveyor system is a common method used for material handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. Many kinds of conveying systems are available and are used according to the various needs of different industries. Has been identified for lifting or transporting bulk materials or products from one place to another in the manufacturing industries depending on the speed of handling, height of transportation, nature, quantity, size and weight of materials to be transported. In today's fast moving, highly competitive industrial world, a company must be flexible; cost effective and efficient to survive. Material handling involves short distance movement within the confines of a building or between a building and a transportation vehicle. It uses a wide range of manual, semi-automated, and automated equipment.

A vertical conveyor system is a type of material handling equipment designed to transport materials or products between different levels of a facility. The system consists of a series of conveyor belts, chains, or other mechanisms that move materials vertically, either upwards or downwards.

When placed at an angle in order to bridge a height difference, such belt conveyors also have the advantage of covering a certain distance. A disadvantage is the loss of much useful floor space as a result of the presence of the necessary supports for the belt conveyor. A bigger distance over a smaller floor area can be bridged using a product lift or a vertical conveyor. A continuous conveyor or a discontinuous conveyor can be chosen as a vertical conveyor. Continuous conveyors can take the form of a spiral conveyor, an L-shaped conveyor or platform lift or a product lift fitted with a fork. But, the complexity of the design along with the manufacturing and maintenance cost associated with it does not attract the small- scale industries.

A Vertical Conveyor System (VCS) is a mechanized material handling solution designed to transport goods, packages, or raw materials between different elevations efficiently. Unlike horizontal conveyors, vertical conveyors optimize floor space by moving loads upward or downward, making them ideal for multi-level warehouses, manufacturing plants, and distribution centers.

These systems are widely used in industries such as:

• **E-commerce & Logistics** (package sorting and distribution)
• **Food & Beverage** (moving products between processing floors)
• **Automotive & Manufacturing** (component supply to assembly lines)
• **Pharmaceuticals** (handling sensitive materials in controlled environments)

Need for Vertical Conveyors:

Traditional material handling methods (e.g., forklifts, manual lifting) have limitations:

1)Space Constraints – Horizontal conveyors occupy significant floor area.
2) Labor Intensity – Manual lifting is slow and increases worker fatigue**.**
3) Speed & Efficiency – Automated vertical systems offer faster, more reliable transport.

A well-designed Vertical Conveyor System addresses these challenges by:
✔**Maximizing vertical space utilization (**critical in high-density storage)
✔**Reducing manual labor** (automated loading/unloading)
✔ **Improving throughput** (continuous movement with minimal downtime)

Problem Statement:

The manual handling of materials in industries, such as manufacturing, warehouses, and construction, is a labor-intensive and time-consuming process. Vertical transportation of materials between different levels of a facility is a significant challenge, leading to:

1. Increased Labor Costs: Manual handling of materials increases labor costs and reduces productivity.
2. Safety Risks: Manual handling can lead to accidents, injuries, and damage to materials.
3. Space Constraints: Limited space in facilities can make it difficult to implement traditional conveyor systems

Objectives:

1. Design a Vertical Conveyor System: Design a vertical conveyor system that can efficiently transport materials between different levels of a facility.
2. Improve Productivity: Improve productivity by reducing manual handling and increasing the speed of material transportation.
3. Enhance Safety: Enhance safety by minimizing the risk of accidents and injuries associated with manual handling.
4. Optimize Space Utilization: Optimize space utilization By designing a compact and efficient vertical conveyor system

II. IDENTIFY, RESEARCH AND COLLECT IDEA

Material Handling involves the movement of materials from one place to another for the purpose of processing or storing. According to American Material Handling society,' Material Handling is an art and science of involving the movement, packing and storing of subsystems in any form. Thus material handling function includes all types of movements vertical, horizontal or combination of both and of all types of material fluid, semi fluid and discrete items and of movements required for packing and storing. The material handling function is considered as one of the most important activities of the production function as out of total time spent by the materials inside the plant area, about 20% of the time is utilized for actual processing on them while remaining 80 %

of the time is spent in moving from one place to another, waiting for processing or finding place in sub-stores. Moreover about 20 % of the total production cost is traceable as material handling cost.

[1] Mr. Nasif Hassan Khan Presented paper on "Fabrication of a Conveyor Chain with Object Sorting and Counting.
Facility" includes factors and basic component used in conveyor system. In this paper we studied about how to use factor and basic component in a conveyor system and avoid accident and defective parts by using control system. In this paper they include design of mechanical and electrical component and program related to control system.

[2]As per Mr. Akshay K. Naphade, Prof. Manish J. Deshmukh who presented Paper on A Review of "Improved Automated Conveyor with Auto Separated System for Oil Packaging Industry".in this case we identify the necessary to sensors and monitoring system for detects the defective products with help of electronic system. This proposed system gives the convenient approach of automatically detecting the weight of oil bottle on the conveyor system using a PLC for high reliability and fast operation without interruption.

[3]Mr. AbhijitGaikwad, Prof. ShreekantPawarare presented paper on "Design and development of automated conveyor system and material handling"and they discussed about the design for Chain conveyor system. In this review we study about Materials and products need to be transported from one manufacturing stage to another.

[4]Mr. Joshua Todd Fluke are paper presented on "Implementing an Automated Sorting System"include the how to sorting product on conveyor system. We are discussed about this project was to create a simulated and theoretical automated process to sort product coming out of the distribution centre. As discuss by Vikas Gupta, Rajesh Bansal, Vineet Kumar Goel, in "A review on material handling equipment And their selection for potential"ApplicationsTransport material handling systems are used to move material for a short or long distance from one location to another like between workshops, between cities, to store, to railway, to ships. The major subcategories of transport material handling systems. In addition to manualsystem, conveyors (like flat Chain, trolley), cranes (like gib, gantry), trucks (like light, heavy) and automatic guided vehicles(AGVs androbots) can be used to shift the material.

[5]Ghazi Abu Taher, YousufHowlader, Md. Asheke Rabbi, Fahim Ahmed Touqir, Automation of Material Handling with Bucket Elevator and Chain Conveyor, International Journal of Scientific Chain conveyor & Bucket elevator are the media of transportation of material from one location to another in a commercial space. Chain conveyor has huge load carrying capacity, large covering area simplified design, easy maintenance and high reliability of operation. Chain Conveyor system is also used in material transport in foundry shop like supply and distribution of molding sand, molds and removal of waste. On the other hand, Bucket elevator can be of great use during bulk material handling. This paper is mainly based on the combination of Chain & Bucket Conveyers to perform complex task within a short time and successfully in a cost-effective way. On account of this, a machine and its physical description is covered here with some basic calculation.

[6]AbhijitGaikwad ,YogeshRaut , JitendraDesale , AkshayPalhe, GovindaShelar, Prof.ShreekantPawar, Design and Development of Automated Conveyor System for Material Handling,In the process or manufacturing industry, raw materials and products need to be transported from one manufacturing stage to another. Material handling equipment are designed such that they facilitate easy, cheap, fast and safe loading and unloading with least human interference. For instance, Chain conveyor system can be employed for easy handling of materials beyond human capacity in terms of weight and height. This project discusses the design calculations and considerations of Chain conveyor system for press machines, in terms of size, length, capacity and speed, roller diameter, power and tension, idler spacing, type ofdrive unit, diameter, location and arrangement of pulley, angle and axis of rotation, control mode, intended application, product to be handled as well as its maximum loading capacity in order ensure fast, continuous and efficient movement of material. The successful completion of this project work is help to the development of an automated Chain conveyor system which is fast, safe and efficient. It is aimed to reduce human effort and at the same time increase the productivity & accuracy levels that cannot be achieved with manual operations.

III. SCOPE OF THE PROJECT or OVERVIEW

The various methods used for material handling in vertical direction are inclined conveyor, lift, robots, spiral conveyors etc. The angle of inclination in case of inclined conveyor is limited to certain value. The inclined conveyor also consumes large amount of space. The lift is another equipment to transfer the material from ground to first floor. The height achieved is higher compared to others. Robots are also used to transfer precise parts from one level to other. Lift

and robot are effective but are expensive. Spiral conveyor is also an important development in vertical material handling system. Push bar conveyor is another system in which a bar supports the object on an inclined conveyor.

Scope of automatic conveyor system:

1. To Increasing in productivity.
2. To reduce human efforts.
3. To reduce accident with the help of sensor and monitoring.
4. To reduce time of material handling.
5. To minimize cost of material handling.
6. Minimize delays and interruptions by making available the materials at the point of use at right quantity at right time
7. Lower investment in process inventory 8. Prevention of damage to materials

IV. DETAILS OF DESIGN, WORKING AND PROCESSES

I.COMPONENTS AND DESCRIPTION

Major Parts:

Motor

Fig.4.1 Motor

A DC gear motor is a type of electric motor that uses direct current (DC) to generate rotational motion. The motor is combined with a gearbox to increase torque and reduce speed.

Types

1. Brushed DC Gear Motors: These motors use brushes to transfer electrical current to the motor's commentator.
2. Brushless DC (BLDC) Gear Motors: These motors use electronic commutation and have no brushes

Applications

1. Robotics: DC gear motors are used in robotics for precise movement and control.
2. Industrial Automation: DC gear motors are used in industrial automation for applications such as conveyor belts, pumps, and valves.
3. Automotive Systems: DC gear motors are used in automotive systems, such as windshield wipers, seat adjusters, and window regulators.

Benefits

1. High Torque: DC gear motors provide high torque at low speeds, making them suitable for applications that require high torque and low speed.
2. Precise Control: DC gear motors can be precisely controlled using speed controllers or position controllers.
3. Compact Design: DC gear motors are often compact and lightweight, making them suitable for applications with limited space.

Specifications

1.Voltage: DC gear motors are available in various voltage ratings, such as 12V, 24V, and 48V.
2.Torque: DC gear motors have different torque ratings, which determine the amount of rotational force they can produce.
3.Speed: DC gear motors have different speed ratings, which determine the rotational speed of the motor.

Chassis (Base frame)

A vertical conveyor system chassis frame is a structural component that supports the conveyor system's components, such as motors, gearboxes, and conveyor Chains. The chassis frame provides stability, strength, and durability to the system.

Design Considerations

1.Structural Integrity: The chassis frame must be designed to withstand the weight and stress of the conveyor system's components and payload.
2.Material Selection: The material selection for the chassis frame depends on the application and must be chosen based on factors such as strength, durability, and corrosion resistance.
3. Modularity: A modular design can make it easier to install, maintain, and upgrade the conveyor system.

Materials

1.Steel: Steel is a common material used for chassis frames due to its strength, durability, and affordability.

2.Aluminum: Aluminum is a lightweight material used for chassis frames in applications where weight reduction is important.

Benefits

1.Stability: A well-designed chassis frame provides stability to the conveyor system, ensuring smooth and efficient operation.
2.Durability: A sturdy chassis frame can withstand the rigors of heavy-duty applications and reduce downtime.
3.Flexibility: A modular chassis frame design can be easily customized to meet specific application requirements.

Applications

1.Material Handling: Vertical conveyor systems are used in material handling applications, such as warehouses, distribution centers, and manufacturing facilities.
2.Production Lines: Vertical conveyor systems are used in production lines to transport products between different stages of production.
3.Logistics: Vertical conveyor systems are used in logistics applications, such as parcel sorting and package delivery.

Fig. 4.2 Base Frame

Bushing

A bushing is a mechanical component that provides a bearing surface for a rotating or moving part, reducing friction and wear.

Fig. 4.3 Bushing

Battery

Fig.4.4 Battery

A DC battery is a type of electrical battery that provides direct current (DC) power to devices and systems. DC batteries are widely used in various applications, including automotive, industrial, and consumer electronics.

Characteristics:

1.Voltage: DC batteries have a specific voltage rating, which determines the amount of electrical potential they can provide.
2.Capacity: The capacity of a DC battery is measured in ampere-hours (Ah) and determines how long the battery can provide power to a device.
3.Self-Discharge Rate: DC batteries can self-discharge over time, which can affect their overall performance and lifespan.

Benefits

1.Portability: DC batteries provide a portable source of power, making them ideal for use in devices that require mobility.
2.Reliability: DC batteries are designed to provide reliable power to devices and systems, even in harsh environments.
3.Flexibility: DC batteries can be used in a wide range of applications, from small consumer electronics to large industrial systems.

Layout:

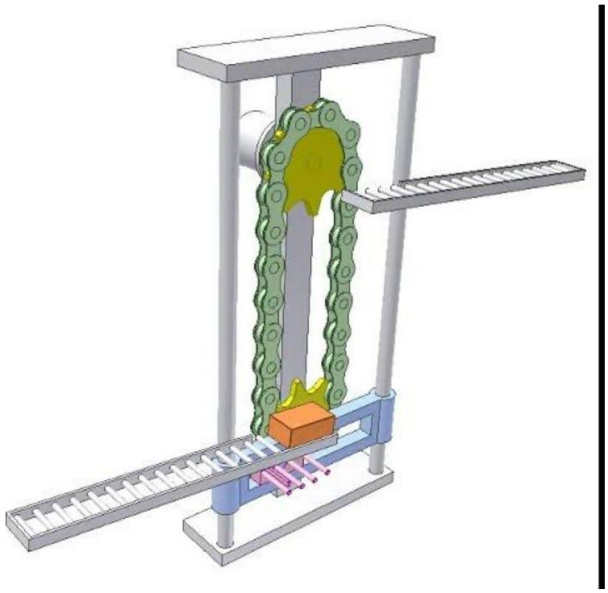

Fig.4.5 3D Drawing of working model

MACHINING PROCESSES

The various machining processes those were used in making The Bucket Conveyor and the Belt Conveyor are described below:

I. Metal Cutting:

Various metal cutting tools were used here such as-

i) Sniping tool: To cut the thin metal sheet to form the shape of bucket.
ii) Hack Saw: To cut the shaft into desired length.
iii) Grinder cutting: To cut the thick metal bar into required length for making frame.

II. Welding:

In this process welding was widely used. As the project was to make a small prototype and there was a small budget for it, welding was used here for most of the joining process. Welding was used to:

1) Attach the sprocket to the shaft.
2) Attach the bearing to the shaft.
3) Hold the bearing in the bearing holder
4) Attach the bearing holder to the frame
5) Form the frame of both bucket and belt conveyor
6) Join the bucket conveyor's driving shaft and belt conveyor's driving shaft to the electric motors.
7) And to join many other parts to the frame.

Working Principle:

Some sequential steps are adopted while building up this machine. Some machining process (such as metal cutting, soldering, welding, facing, turning, grinding, boring and drilling) were identified and incorporated to construct the parts. The main purpose of our working procedure was to build up a functional prototype.

Fig.4.6 Actual Model

V. CONCLUSION

We studied different type of conveyors and their configuration and there working. Thus, Conveyor System use for material handling to improves the speed of material handling. Also, this system reduces the human effort. This system is beneficial and safety for the material handling. The main purpose for building this machine is to automate the handling of bulk material and its packaging. We are trying to build a prototype for expressing our motive on this project. Though we have some mistakes caused by human error but we believe that we can clear our concept by our work. The total process is controlled by a control system automatically. We mainly focus on the packaging system. The control system helps to package the right amount of material in several packets. It stops the machine for a certain time between two packaging process. So once it is set the requirement of skilled operator is also reduced as compared to a manual system.

VI. RESULT AND APPLICATIONS

Result:

The main purpose for building this machine is to automate the handling of bulk material and its packaging. We are trying to build a prototype for expressing our motive on this project. Though we have some mistakes caused by human error but we believe that we can clear our concept by our work. The total process is controlled by a control system automatically. We mainly focus on the packaging system. The control system helps to package the right amount of material in several packets. It stops the machine for a certain time between two packaging process. So once it is set the requirement of skilled operator is also reduced as compared to a manual system.

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