

Fabrication of Pneumatic Series Coupler for Belt Conveyor

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Abstract: A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyor systems are commonly used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed. Many factors are important in the accurate selection of a conveyor system. It is important to know how the conveyor system will be used beforehand. Some individual areas that are helpful to consider are the required conveyor operations, such as transportation, accumulation and sorting, the material sizes, weights and shapes and where the loading and pickup points to need. The applications of belt conveyer while loading in goods carrier trucks or trailers wagon there is limitations of conveyer length & positions. Because the conveyer only transport the materials up to first corner of the goods carrier trucks & next steps to manual material handling inside the truck, so that to overcome this problem we can develop the split belt conveyer in which half part of conveyer is outside the goods carrier trucks & half part of conveyer is inside the truck. The objectives of this concepts to minimize material handling time, effort & cost in the packaging & transportation system industries.

Keywords: double acting cylinder, dc motor, pneumatic fittings, and safety rollers.

1. Introduction

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyor systems are commonly used in many industries, including the automotive, agricultural, computer, electronic, food processing, aerospace, pharmaceutical, chemical, bottling and canning, print finishing and packaging. Although a wide variety of materials can be conveyed, some of the most common include food items such as beans and nuts, bottles and cans, automotive components, scrap metal, pills and powders, wood and furniture and grain and animal feed. Many factors are important in the accurate selection of a conveyor system. It is important to know how the conveyor system will be used beforehand. Some individual areas that are helpful to consider are the required conveyor operations, such as transportation, accumulation and sorting, the material sizes,

weights and shapes and where the loading and pickup points need. Conveyor is used in many industries to transport Goods and materials between stages of a process. Using conveyor systems is a good way to reduce the risks of musculoskeletal injury in tasks or processes that involve manual handling, as they reduce the need for repetitive lifting and carrying. Conveyors are a powerful material handling tool. They offer the opportunity to boost productivity, reduce product handling and damage, and minimize labor content in a manufacturing or distribution facility. Conveyors are generally classified as both Unit load conveyors that are designed to handle specific uniform units such as cartons or pallets, and Process conveyors that are designed to handle loose Product such as sand, gravel, coffee, cookies, etc. Which are fed to machinery for further operations or mixing It is quite common for manufacturing plants to combine both process and unit load conveyors in Its operations.

1) Problem Statement

The applications of belt conveyer while loading in goods carrier trucks or trailers wagon there is limitations of conveyer length & positions. Because the conveyer only transport the materials up to first corner of the goods carrier trucks & next steps to manual material handling inside the truck, so that to overcome this problem we can develop the split belt conveyer in which half part of conveyer is outside the goods carrier trucks & half part of conveyer is inside the truck. The objectives of this concepts to minimize material handling time, effort & cost in the packaging & transportation system industries. The output transportation & packaging can be easily altered in between the process. The statement of project is “Design and fabrication of pneumatic series coupler for belt conveyor” for used packaging & transportation the objects in industry & goods carrier trucks.

2) Objectives

The main objective is to suggest for split conveyer for design optimization. The following are important points regarding this objective of study –Study existing roller conveyor system and its design.

1. Recommendation of new solution for optimization in material handling systems.
2. To reduce the time consumption during packaging& material handling.

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3. To develop automation unit in material handling. So that system can easily be adopted in today's automated packaging plants.
4. To make a machine at low cost, low maintenance, low capital investment in less space.
5. To perform the most rigid operation with high speed transportation with less labor cost.

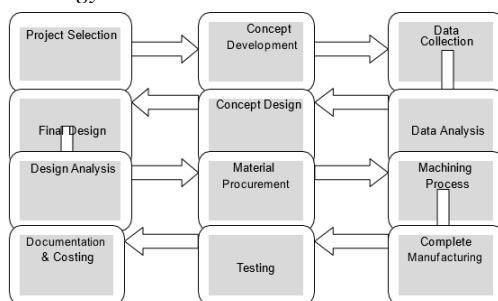
3) Scope

This project will consist of creating a marketable SPM (special purpose machine) based on pneumatic series coupler for belt conveyor for material handling in industrial sector. This project will be completed by April, 2020. The SPM will consist of conveyor belt system for material handling which will reduce man handling of products causing less damages to the product.

2. Literature Review

Vijay. M. Patil say that the expert system approach to conveyor selection provides advantages of unbiased decision making, greater availability, faster response, and reduced cost as compared to human experts. Conveyor types are selected on the basis of a suitability score, which is a measure of the fulfilment of the material handling requirements by the characteristics of the conveyor. This paper discusses the work done by the different researchers for the development of conveyor system for industrial purpose. This paper discusses the development of a prototype expert system for industrial conveyor selection. Conveyor types are selected on the basis of a suitability score, which is a measure of the fulfilment of the material handling requirements by the characteristics of the conveyor. R K Bhojar and C Chanda studied about Belt conveyor is the transportation of material from one location to another. Belt Conveyor has high load carrying capacity, large length of conveying path, simple design, easy maintenance and high reliability of operation. In this paper the study is on adjustable height of belt conveyor for variable speed moving in different direction of a belt conveyor system. It transfers material in two different destinations from a single source. For that it is required to design all the components of belt conveyor like belt width, belt speed, pulley diameter, chute to transfer the material, etc. In large production setups, where the production rates are high and the product to be handled is such that manual transportation is not possible, sophisticated material handling systems would be required.

1) Methodology



The below flow chart shows the sequential operation/steps that will be performed during the project process.

3. Project Overview

Conveyor systems are mechanical devices or assemblies that transport material with minimal effort. While there are many different kinds of conveyor systems, they usually consist of a frame that supports either rollers, wheels, or a belt, upon which materials move from one place to another. They may be powered by a motor, by gravity, or manually. These material handling system come in many different varieties to suit the different products or materials that need to be transported.

A. Conveyor systems specifications

1) Load capacity per unit length

Manufacturers will offer this attribute in cases where the conveyor will be built to a custom length to permit users to determine loading margins.

2) Conveyor belt system speed/rated speed

Belt conveyors are typically rated in terms of belt speed in ft/min. while powered roller conveyors described the linear velocity in similar units to a package, carton, etc. moving over the powered rollers. Rated speed applies to apron/slat conveyors and drag/chain/tow conveyors as well.

3) Throughput

Throughput measures the capacity of conveyors that handle powdered materials and similar bulk products. It is often given as a volume per unit time, for instance, as cubic feet per minute. This attribute applies to bucket, pneumatic/vacuum, screw, vibrating, and walking beam conveyors.

4) Frame configuration

Frame configuration refers to the shape of the conveyor frame. Frames can be straight, curved, z-frames, or other shapes.

5) Drive location

Drives can be located in different places on conveyor systems. A head or end drive is found on the discharge side of the conveyor and is the most common type. Center drives are not always at the actual center of the conveyor, but somewhere along its length, and are mounted underneath the system. They're used for reversing the direction of a conveyor.

6) Types of Conveyors: Belt

Belt conveyors are material handling systems that use continuous belts to convey products or material. The belt is extended in an endless loop between two end-pulleys. Usually, one or both ends have a roll underneath. The conveyor belting is supported by either a metal slider pan for light loads where no friction would be applied to the belt to cause drag or on rollers. Power is provided by motors that use either variable or constant speed reduction gears.

7) Roller Conveyor Systems

Roller conveyors use parallel rollers mounted in frames to convey product either by gravity or manually. Key specifications include the roller diameter and axle center dimensions. Roller conveyors are used primarily in material handling applications such as on loading docks, for baggage handling, or on assembly lines among many others. The rollers are not powered and use gravity, if inclined, to move the product, or manually if mounted horizontally. The conveyors can be straight or curved depending on the application and

available floor space.

8) *Slat Belt Conveyor/Apron*

Slat conveyors use slats or plates made of steel, wood, or other materials typically mounted on roller chains to convey product. The slats are not interlocked or overlapping. Apron/slat conveyors are used primarily in material handling applications for moving large, heavy objects including crates, drums, or pallets in heavy-industry settings such as foundries and steel mills. The use of slats in heavy duty use cases prolongs the service life of the conveyor over other conveyor types that employ belts, which would wear out quicker under the exposure to heavy loads. These conveyor systems are usually powered and come in many sizes and load capacities.

9) *Ball Transfer Conveyor*

Ball type conveyors use a series of mounted ball casters to allow for unpowered, multi-directional conveyance of the product. Key specifications include the ball material and size. Ball transfer conveyors are used in material handling applications such as assembly lines and packaging lines, among others. When positioned where multiple conveyor lines meet, they are used to transfer products from one line to another and are often used in sorting systems. Many sizes and load carrying capacities are available. Ball transfer conveyors are not powered and rely on external forces to move the product along the conveyor.

10) *Chute*

Chute conveyors are material handling systems that use gravity to convey product along smooth surfaces from one level to another. Key specifications include the chute material and the physical dimensions such as length and chute width. Chute conveyors are used for scrap handling, packaging, postal service package or mail handling, etc. Chutes are designed to have a low coefficient of dynamic friction, allowing the product or material to slide easily, and can be straight or curved depending on the needs of the application.



Fig. 1. Belt conveyor system

B. *Components*

1) *Supporting frame*

The frame is of MS material. The frame of our conveyor is basically used to support the all components of system.

2) *Double acting cylinders*

Cylinders are linear actuators which convert fluid power into mechanical power. They are also known as JACKS or RAMS. Hydraulic cylinders are used at high temperature and produce large forces and precise movement. For this reason, they are constructed of strong materials such as steel and designed to withstand large forces. Because gas is an expensive substance, it is dangerous to use pneumatic cylinders at high pressures so they are limited to about 10 bar pressures. Consequently, they

are constructed from lighter materials such as aluminum and brass. Because gas is a compressible substance, the motion of a pneumatic cylinder is hard to control precisely. The basic theory for hydraulic and pneumatic cylinder is same. Parameters consider during the design of cylinder.



Fig. 2. Double acting cylinder

3) *Pneumatic pipe fittings*

Pneumatic tubing is also available in a number of other materials both with and without reinforcement for use in standard applications. SMC fittings incorporate a positive tube seal while the fitting is under pressure which allows polyurethane tubing to be used. This can be used for connection of pneumatic system with assemble.



Fig. 3. Pneumatic hoses and fittings.

4) *Solenoid type 5/2 dc valve*

A valve is a device that regulates the flow of fluid (gases, liquids, fluidized solids or slurries) by opening and closing or partially obstructing passage ways. A 5/2 way directional valve from the name itself has 5 ports equally spaced and 2 flow positions. It can be used to isolate and simultaneously bypass a passage way for the fluid which for example should retract or extend a double acting cylinder. There is variety of ways to have this valve actuated. A solenoid valve is commonly used, a lever can be manually twist or pinch to actuate the valve, an internal or external hydraulic or pneumatic pilot to move the shaft inside, sometimes with a spring return on the other end so it will go back to its original position when pressure is gone, or a combination of any of the mention above.



Fig. 4. 5/2 Solenoid valve.

5) *Timer with relay board*

The repeat cycle timer was developed to control solenoid valves or other components that require periodic energization. This simple control unit will periodically energize a solenoid valve to allow flow of a liquid or a gas for an adjustable period of time. The interval between energization of the valve is called the “dwell time” and is adjustable from 0.1 sec to 10 hours. The “energize time” of the solenoid valve is also adjustable from 0.1 sec to 10 hours.



Fig. 5. Timer.

6) *DC Motors*

A DC motor is a mechanically commutated electric motor powered from direct current (DC). The stator is stationary in space by definition and therefore so is its current. The current in the rotor is switched by the commutator to also be stationary in space. This is how the relative angle between the stator and rotor magnetic flux is maintained near 90 degrees, which generates the maximum torque. DC motors have a rotating armature winding (winding in which a voltage is induced) but non-rotating armature magnetic field and a static field winding (winding that produce the main magnetic flux) or permanent magnet. Different connections of the field and armature winding provide different inherent speed/torque regulation characteristics. The speed of a DC motor can be controlled by changing the voltage applied to the armature or by changing the field current. The introduction of variable resistance in the armature circuit or field circuit allowed speed control. Modern DC motors are often controlled by power electronics systems called DC drives.



Fig. 6. DC Motors

Specification:

DC supply: 12V RPM: 60 at 12V

Shaft diameter: 6mm

7) *Pedestal Ball bearings*

This type of bearing consists of i) a cast iron pedestal, ii) gun metal, or brass bush split into two halves called “brasses”, and iii) a cast iron cap and two mild steel bolts. The detailed drawing of a pedestal bearing is shown in image below. The rotation of the bush inside the bearing housing is arrested by a

snug at the bottom of the lower brass. The cap is tightened on the pedestal block by means of bolts and nuts. The detailed part drawings of another Plummer block with slightly different dimensions are also shown in image below.



Fig. 7. Pedestal bearing

8) *Shaft*

Shaft is a common and important machine element. It is a rotating member, in general, has a circular cross-section and is used to transmit power. The shaft may be hollow or solid. The shaft is supported on bearings and it rotates a set of gears or pulleys for the purpose of power.

9) *Material for Shafts*

The ferrous, non-ferrous materials and nonmetals are used as shaft material depending on the application.



Fig. 8. Shaft

10) *Washer*

A washer is a thin plate (typically disk-shaped) with a hole (typically in the middle) that is normally used to distribute the load of a threaded fastener such as a screw or nut. Other uses are as a spacer, spring (wave washer), wear pad, preload indicating device, locking device, and to reduce vibration (rubber washer). Washers usually have an outer diameter (OD) about twice the width of their inner diameter (ID). Washers are usually metal or plastic. High quality bolted joints require hardened steel washers to prevent the loss of preload due to Brinelling after the torque is applied. Rubber or fiber gaskets used in taps (or faucets, or valves) to stop but, while they may look similar, washers and gaskets are usually designed for different functions and made differently. Washers are also important for preventing galvanic corrosion, particularly by insulating steel screws from aluminum surfaces.



Fig. 9. Washer

11) Nut and Bolt

As nuts and bolts are not perfectly rigid, but stretch slightly under load, the distribution of stress on the threads is not uniform. In fact, on a theoretically infinitely long bolt, the first thread takes a third of the load, the first three threads take three-quarters of the load, and the first six threads take essentially the whole load. Beyond the first six threads, the remaining threads are under essentially no load at all. Therefore, a nut or bolt with six threads acts very much like an infinitely long nut or bolt.



Fig. 10. Nut and Bolt

12) Spur Gear

A gear is a rotating machine part having cut teeth, or in the case of a cogwheel, inserted teeth (called cogs), which mesh with another toothed part to transmit torque. Geared devices can change the speed, torque, and direction of a power source. Gears almost always produce a change in torque, creating a mechanical advantage, through their gear ratio, and thus may be considered a simple machine. The teeth on the two meshing gears all have the same shape. Two or more meshing gears, working in a sequence, are called a gear train or a transmission. A gear can mesh with a linear toothed part, called translation instead of rotation.



Fig. 11. Spur Gear

13) Proximity Switch

A switch is an electrical component that can make or break an electrical circuit, interrupting the current or diverting it from one conductor to another. Switches are made to handle a wide range of voltages and currents; very large switches may be used to isolate high-voltage circuits in electrical.



Fig. 12. Proximity Switch

14) Jaw coupling

This is coupling mainly used to connect the two co axial

shafts. Jaw coupling is positive coupling mainly used in application of transmission system.

15) Rollers

Rollers of conveyers are mainly made from mild steel which is used to support the belt of conveyer.



Fig. 13. Safety Roller

16) Working

The system is consists of mainly first belt type live conveyer outside place in truck & second belt type dead conveyer inside the truck. a pneumatic type locking is use to make coupling within two conveyers system. When we place box or container at inlet side then due to the live belt slide boxes from belt to final end destination either forward or reverse direction towards truck. When we want to couple & transfer the box inside the truck then pneumatic type locking is use to make coupling within two conveyers system to convey the materials inside the truck. During use of belt conveyer while loading in goods carrier trucks or trailers wagon there is limitations of conveyer length & positions. Because the conveyer only transport the materials up to first corner of the goods carrier trucks & next steps to manual material handling inside the truck, so that to overcome this problem we can develop the pneumatic series coupler for belt conveyor in which half part of conveyer is outside the goods carrier trucks & half part of conveyer is inside the truck. After transporting or shifting boxes in trucks we can remove belt conveyer easily. That procedure is reducing packaging time & human efforts.

17) Advantages

1. It can handle only job at packaging & transportation at destination with less time.
2. System can work on the low manpower consumption as compare to the old material handling system.
3. The operation of the new material handling system is well controlled, well balanced system.
4. It approximately increases the efficiency of old material handling system in low cost application machine.
5. The material handling time is less depending on operator speed.
6. Only simple support structures are required design & fabrication is easy.
7. It is a faster process compare to old one.
8. Initial investment is low.
9. More accurate and economical in mass material handling.
10. It minimizes misalignment & less floor space is required.
11. It increases the safety and working condition in material handling.

18) Applications

This conveyor can use in packaging industries where material handling time can be handle by worker packaging efficiency while loading & unloading the boxes in trucks or trailers ex. In pharmaceutical industry for box packing in replacement of belt conveyer.

4. Conclusion

This paper presented an overview of fabrication of pneumatic series coupler for belt conveyer.

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