

Angular Conveyor Belt

Adish Sheregar

Abstract— 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. They are used for general material handling for moving boxes alongside in a factory and other case of bulk material handling such as to transport large volumes of agricultural materials and resources such as ore, salt, grains, coal, sand etc. The conveyor belt has two layers, under layer provides linear strength and shape and is called a carcass and the over layer is called the cover. Polyester, nylon and cotton are the common carcass materials. Conveyors are mostly used in automated distribution and warehousing, and when used in combination with computer controlled handling equipment it allows for more efficient distribution. It is also a labor saving system as it allows large volumes to be transported quickly. Being least expensive and most versatile, these are the commonly used conveyors. And can be used to transfer product in a straight line or through changes in direction or elevation. Such a conveyor system is fabricated which will transfer material at an angular distance i.e. right angle material transfer. This is achieved by coupling the two conveyor systems at right angle to each other and synchronization of material transfer is achieved by two pairs of optical sensors using light emitting diode and light dependent diodes to sense material to be transferred and to operate the DC motor and gear box to operate the belt on roller.

Index Terms—Belt Conveyor, DC Motor, Optical Sensors.

I. INTRODUCTION

When the path for flow of material is fixed then the provision of the conveyors at suitable levels eliminates a good deal of lifting and lowering of materials. Conveyors require no stopping or starting, but are continuous in operation. Transportation is affected by friction between materials being transported by the belt. Belt Conveyor consists of moving endless belt and carries materials within supporting frames. This has a power driven pulley at one end which moves the pulley. Belt is made from rubber fabric or leather. This conveyor is mostly used for handling large quantities of material such as cement, fertilizer, coal ore and other similar materials. These conveyors have the advantage that they largely save labor cost and provide efficiency in material handling.

II. WHAT IS A CONVEYOR SYSTEM?

A conveyor system is a common piece of mechanical handling equipment that moves materials from one location to another. Conveyors are especially useful in applications involving the transportation of heavy or bulky materials. It allows quick and efficient transportation for a wide variety

Adish Sheregar, B.Tech Mechanical Engineering, Mukesh Patel School Of Technology Management And Engineering, Mumbai, India, +91-9867226395

of materials, which makes them very popular in the material handling and packaging industries. Many types of conveying systems are available, and are used according to the various needs of different industries.

Conveyors systems are used widespread across a range of industries due to the numerous benefits they provide.

- i. Conveyors are able to safely transport materials from one level to another, which when done by human labor would be strenuous and expensive.
- ii. They can be installed almost anywhere, and are much safer than using a forklift or other machine to move materials.
- iii. They can move loads of all shapes, sizes and weights. Also, many have advanced safety features that help prevent accidents.

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 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 to be.

A conveyor belt consists of two or more pulleys, with a continuous loop of material-the conveyor belt-that rotates them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors. Those in general material handling such as those moving boxes along inside a factory and, bulk material handling such as those used to transport industrial and agricultural materials, such as grains, coal, ores, etc. generally in outdoor locations. In addition there are a number of commercial applications of belt conveyors such as those in grocery stores. The belt consists of one or more layers of material; they can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called as carcass and an over layer called cover. The carcass is often a cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential.

There are three types of conveyor belts most popularly used:

1. Nylon type with fixture arrangement

Angular Conveyor Belt

Most widely used when the material is to be conveyed horizontally. It is having better strength as compared to the cotton type.

2. Cotton type

It is used when the delicate items are to be conveyed and it absorbs shock up to some extent in better way.

3. Steel Wire Chain Type

It is preferred for the heavy duty work and is having very good strength but it consumes more power as compared to the other ones.

III. CONSTRUCTIONAL DETAILS

The project requires manufacturing the belt driven angular conveyor, which transfers material through right angle using a pair of optical sensor arrangement to start and stop the two conveyors in sequence.

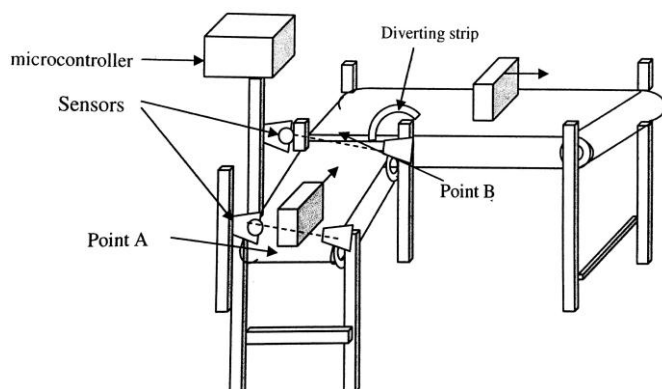


Fig.1 3D representation of project

Belt conveyors are generally fairly similar in construction consisting of a mild steel angle frame with rollers installed on shaft hold by the bearing and the Plummer block arrangement at either end of a flat metal bed. The belt is looped around each of the rollers and when one of the rollers is powered by an electrical DC current operated motor, the belting slides across the solid metal frame bed, moving the product. In heavy use applications, the beds with which the belting is pulled over are replaced with rollers. The rollers allow weight to be conveyed as they reduce the amount of friction generated from the heavier loading on the belting. These conveyor systems are commonly used in postal sorting offices and airport baggage handling systems.

1. Frame

Frames are a one piece fabricated steel construction with inverted mild steel angle and end supports with clearances. The frame is a jig welded for dimensional accuracy and interchangeability. The rigidity and accuracy of frame ensures correct roller alignment and helps keep the belt properly trained. The inverted base angle gives a self-cleaning design eliminating roll and belt damage due to material build-up.

It is made from angle of mild steel of size 40mm x40mm x4mm, also corners are cut at 45 degree and welded in rectangular shape which serves as the base to hold all the accessories as rollers along with the load and prime mover.

The frame after being manufactured is applied with red-oxide and paints to protect it from environmental moisture, which causes the corrosion and erosion. Frame is

provided with the geared DC motor platform to hold prime mover.

2. Drive

Here using the DC motor as the prime mover to roll the rollers and convey the material using the conveyor belt. The specifications of the motor are as follows:

Horse Power: 1/4 HP = 185 watts

Voltage: 6-24 volts 3amp current rating

RPM: 1440 rpm

3. Roller:

There are cylindrical pipe type rollers with the central hole to hold the shaft along with the bearings. It makes convenient to convey the belt along with the load from one place to another.

It sustains all the forces, which are coming due to inter-related motion and due to relative friction between the roller surface and belt material. Hence roller surface is made rough by knurling. Rollers are installed on the frame using single row ball bearings. The diameter of the roller is 45mm dia x 35mm dia x 2.5mm. The shell is made from MS black steel tube.

The three principal functions of each roller are to:

1. Support the belt
2. Rotate to keep the belt moving smoothly.
3. Work reliably under the hardest of conditions, with low energy consumption.

A) Shell:

The shell is usually a steel tube of adequate thickness and diameter to match the required use. It is in direct contact with the belt and may wear excessively when rotational speed differs from belt speed. This can lead to shell thickness failure and finally to the shell collapsing.

B) Shaft:

The shaft is the load bearing element of the roller and must be adequately sized according to load and roller length. It is very important to ensure the bearing and shaft assembly operates under deflection conditions. The shaft is only supported at each end and therefore must accept the load from the shell to the bearings at each end. This results in shaft bending and angular deflection of the bearings. Solid accurately machined bright mild steel provides greater strength and less deflection.

C) Internal sealing ring:

Serves for sealing the bearing and restricting the ingress of impurities from the internal area of roller. It also prevents escape of lubricating grease from the bearing into internal area of the roller.

D) Bearing:

Only radial ball or tapered roller precision bearings are used. Ball bearings are more cost effective. On long horizontal conveyors this can represent noteworthy savings in power consumption as well as increasing the service life of associated drive components.

Bearing seizure is caused due to the following:

- Selection of incorrect bearings may cause overloading of the bearing and its collapse.
- Incorrect tolerances for the bearing fit may result in the bearing overheating.

4. Opto-Sensors:

Opto-Sensors or opto-couplers are made up of a light emitting device and a light sensitive device all wrapped up in one

package but with no electrical connection between the two, just a beam of light. The light emitter is nearly always an LED. The light sensitive device may be a photodiode, phototransistor or more esoteric devices such as thyristors, triacs etc.

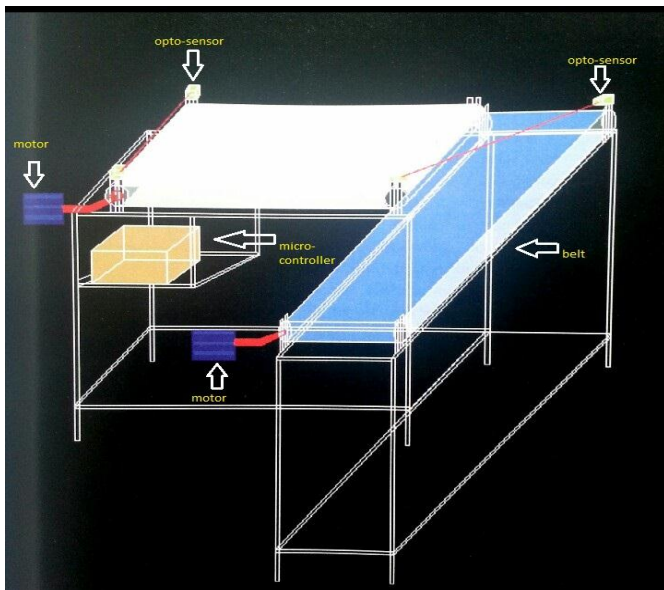


Fig.2 AutoCAD representation

IV. WORKING

- Principle:

It works on the principle that, when the opto-contact between the transmitter and receiver is interrupted with the second geared motor to operate the second conveyor belt is started and the object from first conveyor to the second conveyor is angularly transmitted and conveyed till the preset time in the timer. At the same time the first motor to operate the first conveyor belt is made off.

- Working:

When the job to be conveyed is approached at a point A the monochromatic light ray between the sensors at point A gets cut. Due to this the motor along with the gearing installed at first conveyor roller operates and the job starts moving on first conveyor. As this moving job along with the moving conveyor reaches the point B, the second pair of sensor having monochromatic light ray interrupted operates the second geared motor on the second roller which is kept at the desired angle, operates the conveyor and thus the job is conveyed in angular path.

The pair of opto sensor is working on the photoelectric principle of light emitting diode and light dependent diode operation.

Due to interruption of the light ray between the sensors the relay becomes ON which is responsible to operate the DC motor by allowing the DC current to flow from the battery to the motor.

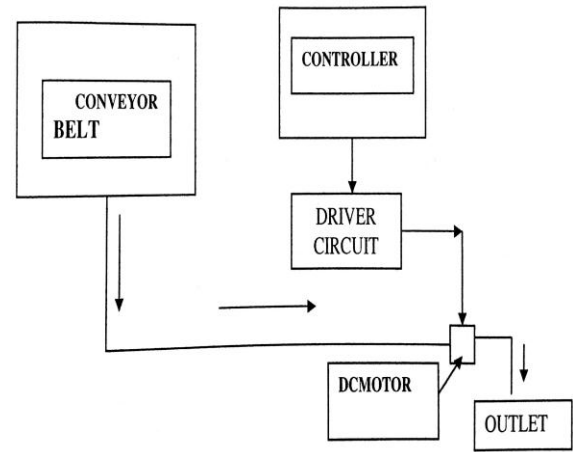


Fig.3 Block diagram of entire system

- Operating procedure:

For the object on the conveyor sensing, LED transmitter and receiver circuit set is used. Between transmitter and receiver one disk is mounted on either side of the object pass path. When that object comes in between the transmitter and receiver, light rays emitted by LED falling on receiver are interrupted. The receiver diode which is initially reverse biased get forward biased when rays falling on it are interrupted, therefore transistor circuits get gate biased and output pulse is obtained. From this circuit a chain of pulses is achieved. This will make the conveyor operating motor switch OFF and switch ON. Thus the object is transmitted with the change of angular position.

Micro-controller controls the actuation of DC motor with the help of driver circuit and power supply circuit.

Actuation of the DC motor is done with the help of the driver circuit. This circuit consists of a power transistor. By the help of this transistor we can on and off the power supply to the solenoid valve, which is supplied from the 24V DC power supply.

V. LIMITATIONS

The project finds limitations in the following mentioned areas:

- The normal design of a belt conveyor is opened. If the product needs to be contained, covers or drip pans can become expensive and cumbersome.
- If the material is sticky, belt cleaning can be difficult and generally not very successful.
- There is almost always material carry over from the belt discharge and this becomes a house keeping problem.
- If the material being conveyed is sticky it will get transferred to the return side of the belt and then to the rollers and idlers, then belt tracking can be an ongoing issue.
- Odder control is virtually impossible.
- Continuous or periodic monitoring of belt is necessary.
- Heat affects the material of belt.

VI. FURTHER APPLICATIONS

In industry the location of the manufacturing section and the assembly and packing systems are installed at some intricate spaces. Hence when the angular transmission of the job is required at that time for automation and rapid transfer of the job through some angular path the angular transmission system which is manufactured is very much applicable. This project is very helpful for such applications.

Apart from this, it is based on the micro-processor based automation technology; it can be used for different intermittent motion works. Opto sensing technology is frequently used on machine tool for filling for rotating some part of the machine through a fractional part of revolution.

VII. CONCLUSION

The project, when implemented by taking proper care of the limitations as mentioned enables a convenient way to convey jobs and products from one place to another place, due to its compact size and being installed on single frame. Also as it is a multipurpose machine it can be used for different applications.

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Adish Sheregar, B.Tech Mechanical Engineering, Mukesh Patel School Of Technology Management And Engineering, Mumbai, India, +91-9867226395