DESIGN AND FABRICATION OF TRUCK BED ATTACHED WITH CONVEYOR BELT

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Abstract: Conveyor Belts are used for loading and unloading. The systems are designed to move large family of material transport equipment over fixed path. In these project we will design and fabrication of a cargo bed which is the back part of the truck where are the goods are placed. The base part of the cargo bed is made of a conveyor belt where the load will bear. The design of cargo bed will in v-shape so that the load concentration over the conveyor belt will be reduced when compared with u-shaped cargo bed. For the operating of conveyor belts we use low speed and high torque DC Motor. The goods will unload from the truck by using conveyor belts.

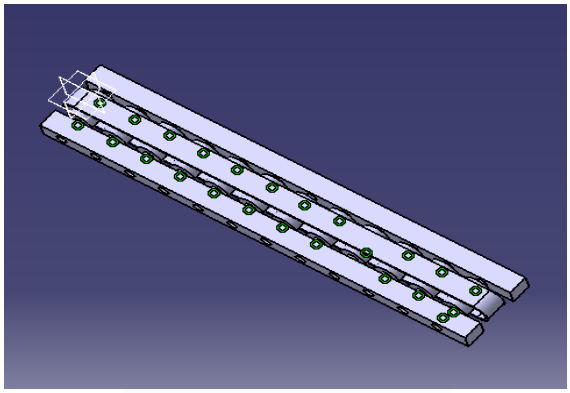
Index Terms **– conveyor belt, cargo bed, concentration, DC motor.**

I. INTRODUCTION

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 labour required in a manufacturing or distribution facility. All lifting and conveying machines can be divided by their operating principles into two large groups: (i) Intermittent motion, (ii) Continuous motion Intermittent motion includes all types of cranes, lifts; surface transport means (trucks, loaders, prime movers), aerial tramways and cable ways, scrappers and the like. Continuous motion includes conveyors, pneumatic and hydraulic transport means etc. which may generally called continuous transport machines or conveying machines. Continuous machines are characterized by non-stop motion of bulk or unit loads along a given path, without halts for loading and unloading. At the same time they can distribute loads among a number of destination points, deliver them to stores, and transfer products from one technological operation to another and ensure the desired pace of a production process.

II. WORKING

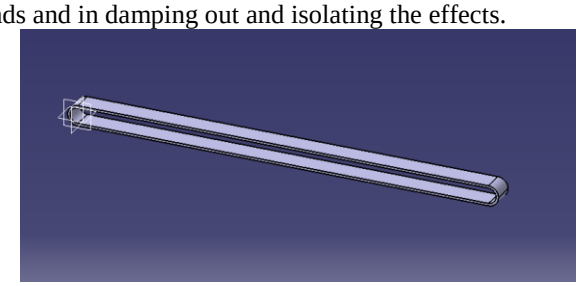
This project is based on rubber conveyor belt. As the pulley moves belt starts to rotate in forward direction. Idlers help in maintaining close contact with the pulley. Material is collected mechanically or manually at other end. Belt then returns again at the point of feeding. Conveyor belts are basically very wide belts attached in a loop to two or more turning rotors driven by motors. The loop is the actual conveyor belt, and is generally made of two or more layers of rubber, one layer to give shape and structure to the belt and one to allow it to transport its load safely. This conveyor loop is generally attached to two wheels, called rotors, which are spun by motors. The conveyor belt has enough friction between it and the rotor that it sticks to this rotor. As a rotor turns, the conveyor belt will turn as well due to the intense friction between the rotor wheel and the belt. This turning motion of the rotor causes one side of the belt to move in one direction, while the other moves in the opposite direction. This means that both wheels must always be moving in relatively the same direction, either clockwise or counter-clockwise. If the two rotor wheels moved in opposite directions, the conveyor belt would not travel at all.



2.1 Working of conveyor belt

2.1 BELT

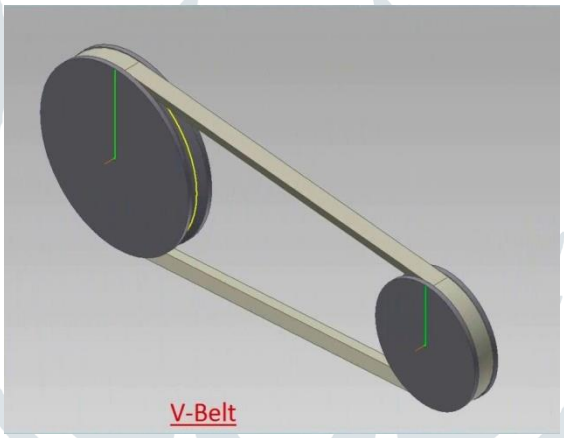
Belts, ropes, chains, and other similar elastic or flexible machine elements are used in conveying systems and in the transmission of power over comparatively long distances. It often happens that these elements can be used as a replacement for gears, shafts, bearings, and other relatively rigid power-transmission devices. In many cases their use simplifies the design of a machine and substantially reduces the cost. In addition, since these elements are elastic and usually quite long, they play an important part in absorbing shock loads and in damping out and isolating the effects.



2.2 Belt

2.2 PULLEYS

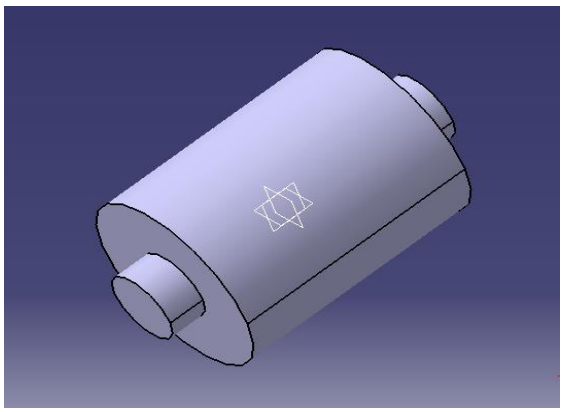
A pulley is a wheel on an axle that is designed to support movement and change of direction of a cable or belt along its circumference. Pulleys are used in a variety of ways to lift loads, apply forces, and to transmit power. In nautical contexts and conveyors. A pulley is also called a sheave or drum. Pulleys used in this conveyor change the direction of the belt on the conveyor as well transmit the mounted two wheeler on the conveyor from ground into the trailer and vice a versa. The pulleys also act as a tension between the conveyor belt so as to keep it without any slag. As a rotating element in conveyor, driven pullies are often given the motion by means of rope, belt drive or motor. The means of pulley rotation in this system is a motor.



2.3 Pulley

2.3 ROLLERS

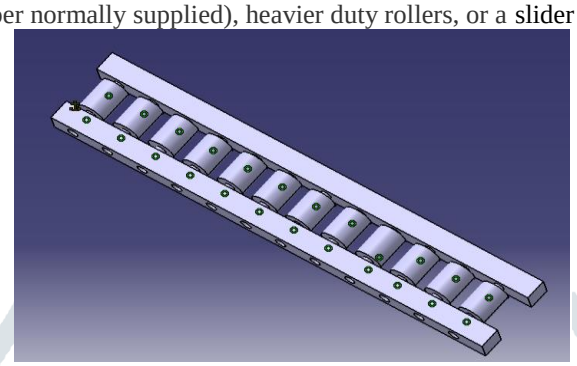
Support the belt and are guaranteed to rotate freely and easily under load. They are the most important components of the conveyor and represent a considerable value of the whole cost. The correct sizing of the roller is fundamental to the guarantee of the plant efficiency and economy in use.



2.4 Roller

2.4 ROLLER BED

A roller bed is a belt-type conveyor that uses rollers as the supporting surface for the belt. A good rule of thumb is to have at least two rollers under the belt supporting the shortest item being conveyed. This will give the item a reasonably smooth ride. The selection of the size of the carrying rollers is a function of the weight of the item being conveyed, the belt speed, and the manner in which the items are placed on the belt. Normal loading would simply be from a gravity or powered conveyor transferring a package. This is a smooth transition; packages transferring from the discharge end of a gravity or powered conveyor to the infeed end of this belt conveyor do not cause a mechanical shock to the roller bed. If packages are hand loaded onto the belt, there is a strong possibility that the packages might be thrown and dropped onto the belt, causing damage. We might consider more rollers (twice the number normally supplied), heavier duty rollers, or a slider bed in the area of impact only.



2.5 Roller bed

2.5 BEARINGS

All the idlers are supported by bearings. The bearings provide a seating for the idlers and prevent the movement of the assembly. The force that acts on these idlers is transmitted to the bearings. The bearings are selected from the standard SKF catalogue. In our case, the rotating speed is less although the torque is more. Since our there won't be any axial forces in our application, standard single row deep grove ball bearings are used.

2.6 Bearing

III. LITERATURE REVIEW

[1] Gabriel Fedorko et al. [2012] the article deals with analysis of force conditions in a belt of classic belt conveyor by FEA. Analysis determines rolls contact forces acting on the belt at idler station. Knowledge of physical, mainly mechanical, properties of conveyor belt rubbers belongs to important preconditions of trouble-free operation of conveyor belt transportation. Mechanical nature of rubber materials used in belt transportation have among others an immediate effect on the friction between rubber layers of a conveyor belt and a driving drum and/or on the total power consumption. This knowledge is relevant not only in the case of new belts where it helps their optimal selection with respect to the nature and quantity of transported material but also during monitoring the belt changes caused by operation .

[2] Konakalla Naga Sri Ananth et al. [2013] studied 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. Belt Conveyor system is also used in material transport in foundry shop like supply and distribution of moulding sand, moulds and removal of waste. This paper provides to design the conveyor system used for which includes belt speed, belt width, motor selection, belt specification, shaft diameter, pulley, gear box selection, with the help of standard model calculation.

[3] Amit M. Sarode et al. [2015] studied a z-type conveyer system provide a fast loading and unloading of trucks and any other transport vehicle. It conveys the package material from storage area to trucks for further transportation. The device

consists of chain drive system for running the ending roller which moves the conveyer belt. Principal area of shopping mall, departmental store, hotel and public building. Our research paper includes construction of z-type conveyer system. We can use this project in Automation mode which helps in the conservation of energy.

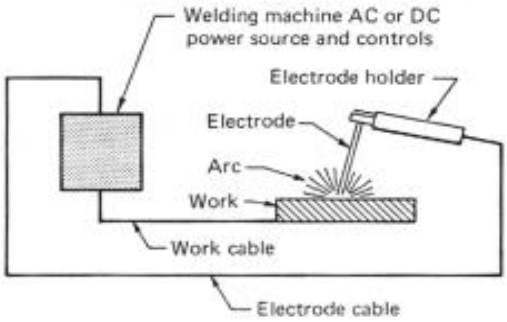
[4] Abhishek Kumar et al. [2017] ATLS vehicle loading technologies significantly reduce the manpower required on the shipping and receiving docks, eliminate product damage, accidents, and ergonomic injuries related to lift-truck operation. Generally, products can be loaded quicker and product density is increased resulting in more payload per shipment which reduces shipping cost, using a loading automation system. Loading automation is often the key component to achieve complete plant automation. In this thesis, a system of Mechanical Conveyor belt has been developed and proof of concept has been tested for further testing and trial purpose. The main reason behind proposed system is to automate small scale industries which are not able to afford expansive automation systems.

IV. FABRICATION

Fabrication is a process of doing a work by using the different operations, such as welding, grinding, drilling and etc. The operations which are used in fabrication of our project are explained below. In the fabrication of this project a long square pipe is used for making stand and by using the gas cutting the square pipe is cut with required dimensions. These square mild steel pipes are welded together to get the stand with required dimensions. The bearings are fixed to stand by using bolts and nuts. A hand drilling machine is used to make holes on the stand with required dimensions. Then the bolts and nuts are tightened. A mild steel solid shaft is used as rollers. The shaft diameter at the both ends are turned on the lathe to insert into the bearings. The rollers are fixed in between the two bearings. At one side of the shaft will be little bit of length present at outside of the bearing. The circular mild steel plate with required dimensions are taken. Then a pin is welded to it at proper position and also a handle is attached to it. Then the conveyor belt fabrication is completed. Again a same diameter mild steel plate is taken and four slots are marked on it. By using gas cutting the slots are removed. The curves also removed by gas cutting and it is welded to the one side of shaft. Before assemble the grinding machine is used for the finishing. Now assemble the all parts, so that the fabrication of operated belt conveyor is done. The operations which are used for the fabrication of this project such as welding, drilling, gas cutting, grinding and turning are explained below.

4.1 Welding:

Welding is a fabrication process that joins materials, usually metals or thermoplastics, by causing fusion, which is distinct from lower temperature metal-joining techniques such as brazing and soldering, which do not melt the base metal. In addition to melting the base metal, a filler material is typically added to the joint to form a pool of molten material that cools to form a joint that is usually stronger than the base material. Pressure may also be used in conjunction with heat, or by itself, to produce a weld. Welding also requires a form of shield to protect the filler metals or melted metals from being contaminated or oxidized. Although less common, there are also solid state welding processes such as friction welding or shielded active gas welding in which metal does not melt.



4.1 Welding

4.2 Gas cutting:

Apart from using hacksaw, power saw, chisels, etc. for metal cutting operation, gas cutting is extensively used now-a-days in industry. The process consists of preheating the metal to be cut to its ignition temperature. The preheating is done by oxy-acetylene gas flame, which is supplied from surrounding openings of the cutting torch. When this temperature is attained, a jet of high pressure oxygen from a central opening of the cutting torch is directed on the red hot metal. The metal is rapidly oxidized, and slag is formed. This slag is washed out by the jet of oxygen. It employed only when the ignition (oxidation) temperature of the metal being cut is lower than its melting point. The process involves ensuring that the melting points of the formed oxides are lower than that of the base metal itself. The gas cutting is shown in figure.

4.2 Gas cutting

4.3 Drilling:

Drilling is a cutting process that uses a drill bit to cut a hole of circular cross section in solid materials. The drill bit is usually a rotary cutting tool and it has multipoint cutting edges. The bit is pressed against the work piece and rotated at rates from hundreds to thousands of revolutions per minute. This process is used for making holes on materials. The figure shows the drilling operation.

4.3 Drilling

4.4 Grinding:

Grinding is an abrasive machining process that uses a grinding wheel as the cutting tool. The grinding wheel consists of a small abrasive particles which have the sharp cutting edges. This process is used to obtain fine surface finish. In grinding the material is removed by means of large number of cutting tools constituted by projected abrasive particles. The figure shows the grinding operation.

4.4 Grinding

4.5 Turning:

Turning is a form of machining, a material removal process, which is used to create rotational parts by cutting away unwanted material. The turning process requires a turning machine or lathe, work piece, fixture, and cutting tool. It is shown in figure.

4.5 Turning

V. RESULTS AND DISCUSSION

Dimensions of the truck bed:

- Length = 53cm
- Width = 26cm
- Depth = 15cm
- Height = 25cm
- Dimensions of the truck bed capacity : 3kg

- Parts of truck bed :

  Motor capacity =12v,5amps

  Conveyor capacity (Q) = ρAv

where

Q = conveyor capacity (kg/s, lb/s)

ρ = density of transported material (kg/m^3, lb/ft^3)

A = cross-sectional area of the bulk solid on the belt (m^2, ft^2)

v = conveyor belt velocity (m/s, ft/s)

The cross-sectional area of the bulk solid on the belt can be expressed as

$A = Ub^2$

where

U = non-dimensional cross-sectional area shape factor

b = contact perimeter between bulk material and belt (m, ft)

$Q = \rho A v$; $v = \pi dN/60$ m/s

Where

d = diameter of the pulley = 0.02 m

N = motor speed = 10 Rpm

v = π×0.02×10 /60 m/s

v = 0.01 m/s

ρ = mass / volume

= 3kg /(0.053×0.026×0.01)

= 21.7×10^4 kg/m^3

A =Ub^2

= 1×(0.053)^2

= 2.8×10^-3 m^2

Q = ρ A v

= 21.7×10^4 × 2.8×10^-3× 0.01

= 6.076 kg/s

Thickness of the conveyor belt (T) =3mm

Length of the belt (L) =(D+d)/2×π+2C

D=diameter of drive pulley =25mm

d=diameter of driven pulley =45mm

C=centre to centre distance =49.8cm

L=((2.5+4.5)/2)×3.146+2×49.8
L=110.6cm

Roller dimensions:

- outer diameter =31mm
- inner diameter =29mm
- Material used = steel
- Density =7.85gm/cc
- Length =20cm
- Weight =331.45gms
- No. of rollers =12
- Total weight =3.9kg
- Conveyor belt type : Rubber belt

- Grade → N-17

- Transporting for coal, wood, chips, clay, cement, sand, etc…

- Temperature range → -35ºc to 60ºc

- Coefficient of friction : F=μN

F= frictional force
μ= coefficient of friction
N= normal force
μ=F/N
F=Load × acceleration due to gravity
= 3×9.81
= 29.43N
N=Load weight + conveyor weight + roller weight
=(3+0.25+3.9)×9.81
=70.14N
μ=mg/N
μ=29.43/(70.14)
=0.42
Power consumption (P) =V×I
=12×5
= 60 watts
Roller to roller gap = 10mm

VI. CONCLUSION

We have successfully calculated the angular velocity and acceleration of the Geneva wheel. For the designed Genera wheel and the roller conveyor the time required by the material to cross the entire belt is calculated accurately. The entire modeling of the project is done with the help of CATIA V5. In addition to this. The project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is good solution to bridge the gates between institutions and industries.

VII. SCOPE FOR FUTURE WORK

- In this project due to the shortage of fund only CAD model and Simulation has been carried out.
- The design of conveyor system can be tested by fabricating it in a real life situation.
- Dynamic Analysis can be possible to perform
- Selection of appropriate material. By selecting inferior quality of material further weight reduction of conveyor is possible.
- One common motor of 60 watts should be used with different transmission system.
- NVH (Noise vibration and Harshness) Analysis can be possible for better and safer results.

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